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—AND—

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THE AMERICAN

Meteorological Journal.

VOL. II. DETROIT, JULY, 1885. NO. 3.

EDITORIAL NOTE.

LONG-RANGE PREDICTIONS.—Considerable space has been devoted in this JOURNAL in the last few months to the principles and application of weather-prediction for considerable time in advance. The subject is a matter of great importance—important to every one, but especially important to those who depend on the general weather conditions for their livelihood, farmers, shippers and others. This importance has seemed to justify publishing everything on the subject which had a fair amount of promise in it, provided the studies and predictions were founded on scientific principles, and also provided that the principles on which they depended were not kept secret, but as fully explained and set forth as possible. We do not necessarily accept the views of our weather-predicters any more than we accept completely the views set forth in other contributions signed by the authors. We only consider them sufficiently hopeful to justify us in placing them before an intelligent and critical public and leaving them to the fate which test and discussion must, sooner or later, decide for them. Meantime, any contribution on the subject of long-time predictions, with the above provisos, will be welcomed by us.

We can not, however, refrain from saying that, in our opinion, the authors of the recent long-time predictions deserve the intelligent sympathy of their readers. They have spent, and are spending,

very much labor on the subject. Nor will we refrain from saying that, in view of the studies by which it has been shown that tropical weather-areas move gradually eastward, and in view of the farther fact that it is known positively that the cold area of last winter moved slowly eastward from British Columbia to New England, we think that these authors are on the track of an important truth. We doubt if the information is yet sufficient to enable them to predict with certainty for a month ahead. The general weather-areas seem sometimes to move westward, and they have occasional hesitations and perturbations not yet understood. But we believe that continued work, and full discussion by all those who are competent to judge, will in time bring the matter into full light.

CURRENT NOTES.

JULY PREDICTIONS.—The area for which the following forecasts are attempted, is the part of the United States east of the Mississippi River. It is probable that the period of high pressure which prevailed over this area during the middle of June will be replaced the last few days of June and the first ten days of July by a period of generally lower pressure, accompanied by considerable rainfall. It is also probable that over a large part of this area the mean temperature of the first ten days of July will be lower than during a period of corresponding length near the middle of June. This area of cooler weather will most probably include New England and the eastern states. The area of low pressure will be followed the next 15 days by a period of generally higher pressure with less rainfall and a higher mean temperature over at least a portion of this area. Attempting still greater detail for the first part of the month, it is probable that a comparatively high pressure with fair weather will prevail about July 1st, and between the 3d and 6th decidedly lower pressure will prevail with much rainfall. Higher pressure with fair weather will probably again prevail between the 7th and 8th, followed by low pressure with rain between the 10th and 13th and a decidedly high pressure area about the 14th. The depressions which will probably pass between the 3d and 6th and 10th and 13th will be preceded by a day or two of hot sultry weather and followed by a day or two of cooler weather. H. HELM CLAYTON.

Mr. Sherman's Predictions for July.—A typographical error in my predictions for June, as published in the JOURNAL, made me say that the month would bring "an average of pleasant weather, but *severe* unpleasant and chilly weather." What I wrote was, "*some* unpleasant and chilly weather." The prediction has been fulfilled, two quite severe cold waves having been felt, one bringing frost in Dakota and Minnesota, and the other in Central Michigan.

The conditions now existing do not exhibit any marked eastward movements of weather areas except cyclones occupying but a few days in their passage to the Atlantic coast, and there is nothing to indicate any special variation from the normal during July, either in rainfall or temperature. The rains of the month will be largely of local character, and thunder showers, and in some sections may be frequent enough to interfere somewhat with harvesting operations; but in general a favorable month for growing crops may be confidently anticipated.

LOREN A. SHERMAN.

REVIEW OF EUROPEAN WEATHER FOR MARCH AND APRIL by Dr. M. Buysman, Middleburg, Holland:

MARCH.

Barom. pressure.—On the 1st and 2d there are two areas of high pressure, one over Britain and another over Russia, but on the 3d there is only one, situated over Scandinavia, while a low pressure advances in the west; by this time light frost is observed in Germany and severe cold in Scandinavia; travelling easterly the minimum over Britain has sent out another into Germany, causing there general rain and snowfalls. Another depression is situated on the 6th over France, causing considerable precipitation there and over Germany. On the 7th this minimum has travelled to western Russia, and another is situated in north Scandinavia; high pressure now advances in the west, while another maximum has developed over Austria; the low pressure in the north disappears on the 12th in the northeast, and high pressure spreads over central Europe with light frost and calm clear weather. A low pressure has developed over Italy, causing strong or stormy northeast winds over north Italy and south Germany. Over northern Scandinavia the depressions now travel rapidly with rain and snowfall. But on the 17th a minimum appears northwest of Scotland, where fresh gales are blowing with rapid falling barometer. On the 18th this depression hovers over Scandinavia, where the barometer has

fallen to 28.96. Another minimum appears on the 20th on the Norwegian coast, and, travelling easterly, it hovers on the 21st over Finland with a stand of the barometer in the centrum of about 28.50, causing storm on the Baltic coast and also over northern Germany. On the 24th this disturbance has passed away in the northeast, and high pressure with severe cold appears over Finland. Over Germany the pressure has increased with snowfall and sinking temperature; frost is now general as far as western and southern France. A slight minimum over Italy causes there precipitation with stormy easterly winds. On the 26th another disturbance approaches in the northwest, but disappears on the 28th in the north. Another appears on the 29th, but takes the same route. High pressure has developed on the 31st over northern Germany, and also over Britain, with calm and foggy or clear weather.

Temperature: Germany.—The temperature was below the normal from the 10th to the 13th, 22d to the 26th, and 29th to the 31st; it was above the mean from the 1st to the 9th, 14th to the 21st, and 27th to the 28th; lowest temp., at Kaiserslautern, 20°, on the 24th; highest, on the 18th at Breslau, 54°.

Russia, St. Petersburg.—The temperature was below the mean from the 3d to the 8th, 11th to the 16th, and 22d to the 25th; it was above the mean on the 1st to the 2d, from the 6th to the 10th, 17th to the 21st, and 26th to the 31st; lowest temp., on the 14th and 16th, 5°; highest, on the 30th, 43°.

Valentia, Ireland.—The temperature was below the mean on the 1st, 2d, 5th to the 15th, and 23d; it was above the mean on the 3d, 4th, 16th to the 22d, and 24th to the 31st; lowest temperature, on the 10th, 35°; highest, on the 13th, 14th and 20th, 53°.

APRIL.

Barom. pressure.—On the 1st and 2d there is a low pressure in the northwest and a maximum over central Europe, but on the 3d the depression disappears in the north, while the high pressure spreads over Britain and the North Sea with generally fair weather; at the same time another depression appears over the Mediterranean, causing rain in Italy. On the 5th the maximum has travelled to north Scandinavia and a new disturbance approaches from the Atlantic, and, after uniting with the minimum in the south, is divided on the 7th into three depressions, one over central Europe, one over the Mediterranean, and another over the Gulf of

Biscay. On the 9th there are only two minima observed, one over Holland and another over the Adriatic; while a maximum has formed in the northwest the area of low pressure over central Europe remains the same till the 15th; on this date the high pressure in the northwest has travelled to Scandinavia and a minimum is observed over Finland, causing snowfall. Another maximum appears over Austria and Russia, and, uniting on the 16th with the high pressure in the north, trends two areas of low pressure, one over France and another over Finland. The latter disappearing on the 17th, the maximum spreads over the whole of northern Europe, while the low pressure in the south increases; a new minimum appears on the 19th in the northwest and the area of high pressure recedes to Denmark, and on the 20th to central Europe. Low pressure now spreads over northern Europe, causing stormy winds and snow over Sweden and Finland; this area extends on the 24th to Spain. Another disturbance appears on this date on the western shores of Britain, where the barometer has fallen to 28.75 with severe storm; this minimum, however, recedes on the 26th, and is nearly filled up on the 30th after sending out branches to central Europe, the latter causing rain and thunderstorms in Germany.

Temperature: Germany.—From the 1st to the 6th, and 11th to the 16th it is below, and from the 7th to the 10th, and 17th to the 30th it is above the mean; lowest temperature, 31° at Königsberg on the 16th, and Neufahrwasser on the 1st; highest, on the 29th at Breslau, 77°.

Ireland, Valentia.—From the 1st to the 7th, 13th to the 17th, 22d to the 23d, 25th to the 26, and on the 29th it is below; from the 18th to the 21st, on the 24th and 28th it is above the mean; from the 8th to the 12th, on the 27th and 30th it is normal; lowest temperature, on the 1st, 2d, 3d, 5th, 6th, 7th, 13th and 15th, 45°; highest, on the 18th, 56°.

Russia, Petersburg.—Temperature below the mean: 13th to the 23d, and 29th to the 30th; above the mean: 1st to the 12th, and 24th to the 28th; lowest temp., on the 14th, 14°; highest, on the 24th, 52°.

Sweden, Stockholm.—Temperature below the mean: 13th to the 16th, 19th, 29th, 30th; above the mean: 1st to the 12th, 17th, 18th, 20th to the 28th; lowest, on the 5th, 6th and 14th, 27°; highest, on the 23d, 64°.

ROYAL METEOROLOGICAL SOCIETY.—The usual monthly meeting of this society was held on Wednesday evening, April 15th, at the Institution of Civil Engineers, 25 Great George street, Westminster, Mr. R. H. Scott, F. R. S., president, in the chair, when the following papers were read:

(1) "Report of Committee on Decrease of Water Supply." This committee was appointed to take into consideration the question of the decrease of water in springs, streams and rivers, and also the simultaneous rise of the flood-level in cultivated countries. As far as any inference can be drawn from the records collected by the committee, it appears that the years 1820, 1821, 1824, 1835, 1838, 1845, 1847, 1850, 1854, 1855, 1858, 1859, 1864, 1865, 1871, 1874, 1875 and 1884 have been periods of marked low water. On the other hand, the years 1817, 1825, 1830, 1836, 1841, 1842, 1853, 1860, 1861, 1866, 1873, 1877, 1879, 1881 and 1883 have been periods when there has been exceptionally high water. In 1852 the water was very low in the early part of the year, while at the end of the year it was very high. In the intervening periods the water has been of moderate altitude. It does not appear from existing records that there is any diminution in the water supply of this country, and the large quantity of water which has been stored or has flowed off the ground between 1876 and 1884 is confirmatory of this view. There appear, however, to be periods when there is exceptionally low water, and these are almost immediately followed by periods of exceptionally high water. With reference to the increase of floods, it does not appear from the records that there is any great increase in the height to which the floods rise in this country. Whether or not the height to which floods have risen in recent years has been affected by river improvements and the greater facility with which floods can be got rid of, or whether there is a diminution in the quantity of water, are questions upon which the committee have not at present sufficient information to speak positively.

(2) "Report of Committee on the Occurrences of the Helm Wind of Cross Fell, Cumberland, from 1871 to 1884." In response to a letter inserted in the Penrith newspapers, the committee has received a number of communications bearing on the subject of the Helm Wind. With the view of ascertaining as far as possible the meteorological conditions which exist when the Helm Wind is blowing, all the recorded occurrences that have been received have been chronologically arranged. The first systematic record com-

mences in 1871, and in this report the committee deals with all occurrences from that date to the end of 1884. Since that time more detailed records have been commenced at numerous stations in the locality at the instigation of the Royal Meteorological Society. Ninety-three instances of the Helm Wind were recorded from 1871 to 1884; the months with the greatest frequency being February, March, April and November. On examining the daily weather reports it was clearly seen that whenever the Helm Wind was blowing there was an easterly wind not only in the locality, but generally over the entire country. As the Helm Wind seemed to occur so regularly with the easterly wind, the committee further extended the inquiry with regard to the east wind. The daily weather charts were consequently examined for each day from January 1st, 1871, to December 31st, 1884, and every occurrence of east wind tabulated; the instances with general easterly conditions over the whole country being kept separate from those instances in which the easterly wind was only partial, though of sufficient intensity to occasion the Helm Wind. This examination showed that although the wind over the United Kingdom is generally easterly when the Helm occurs, yet the Helm by no means occurs whenever the wind is easterly. Indeed, this step in the inquiry has not at all tended to the elucidation of the phenomenon in question, for it frequently happens that the conditions are to all appearances precisely similar when the Helm is on, and yet no such occurrence has been recorded. This may in part be due to the occasional omission to record the Helm, although it cannot possibly be in the main attributable to such an omission; but it points to other conditions being necessary besides absolute agreement of wind direction and isobaric lines. Possibly the different hygrometric qualities of the air with the existing easterly winds may be an important factor in deciding whether or no the Helm will be formed, but it is not readily conceived why even in this case the Helm Wind should not blow. It must, however, be borne in mind that the surface winds can only be examined, whilst those at a comparatively small elevation may be intimately connected with the phenomenon. From the observations made prior to those started at the beginning of 1885 no idea can be formed of the behavior of the upper currents even at the time of the occurrence of the Helm Winds, far less with the occurrence of each east wind

experienced. The society has, however, provided for the extension of the inquiry in this direction in the records which are now being collected, the observers supplying observations of the upper currents by means of the clouds, as well as the direction of the winds at the surface of the earth. As soon as a sufficient number of these observations have been received the committee hopes to present a further report which will tend to explain the phenomenon of the Helm Wind.

(3) "Results of Meterological Observations made at Asuncion, Paraguay," by R. Strachan, F. R. Met. Soc.

The May meeting of this society was held on Wednesday evening the 20th, at the Institution of Civil Engineers, 25 Great George street, Westminster, Mr. R. H. Scott, F. R. S. president, in the chair.

Dr. H. Dobell and Mr. J. N. Longden were elected Fellows of the Society.

The following papers were read:—

(1) "The Temperature Zones of the Earth considered in relation to the duration of the hot, temperate, and cold period, and to the effect of Temperature upon the organic world," by Dr. W. Köppen, Hon. Mem. R. Met. Soc.

(2) "Velocities of winds and their Measurement," by Lieut. Col. H. S. Knight, F. R. Met. Soc. The author after describing the various ways of ascertaining the direction and velocity of the wind, makes several suggestions for the improvement of Robinson's anemometer.

(3) "On the equivalent of Beaufort's Scale in Absolute Velocity of Wind," by Dr. W. Köppen, Hon. Mem. R. Met. Soc. The author refers to Mr. C. Harding's paper read before the Society in December last on the anomalies in the various wind velocities given by different authors as equivalents for the numbers in Beaufort's Scale, and, as illustrating the point, calls special attention to the want of agreement between the velocities obtained by Mr. Scott, and those subsequently obtained by Dr. Sprung, and confirmed by himself.

(4) "Note on a peculiar form of Auroral Cloud seen in Northamptonshire, March 1st, 1885," by the Rev. James Davis.

INTERNATIONAL COMMITTEE OF METEOROLOGY.—The following translation of the Circular Letter of this Committee has been kindly communicated by the Chief Signal Officer:

INTERNATIONAL COMMITTEE ON METEOROLOGY,
ST. PETERSBURG AND LONDON, May 1, 1885.

SIR AND HONORED COLLEAGUE:

In compliance with the instructions of the International Congress on Meteorology at Rome, we have the honor to inform you that the International Committee on Meteorology instituted by this congress will meet for a third session in Paris in the beginning of the coming September and that up to the present time the following questions have been proposed for consideration during this session:

(1) Report of the secretary on the labors of the Committee since the meeting at Copenhagen.
(2) Report of Messrs. Brito Capello, Hildebrandsson and Ley on the observation of the cirrus.
(3) Does it seem opportune to soon convene a third International congress of Meteorologists?
(4) Establishment of stations of the first order on the Congo.
(5) Discussion on the utility of the summaries of the state of the weather as published in the different countries, and the eventual preparation of plan for more uniformity.
(6) Discussion of the utility of the meteorological telegrams from America proposed by Mr. (General) Hazen and of an eventual organization for their distribution in Europe.
(7) By what means can the timely receipt of meteorological telegrams be assured?
(8) Should the reduction of barometer readings to gravity under 45° of latitude be generally introduced?
(9) Is it desirable to also count in Meteorology the hours of the day from 1^h up to 24^h according to the resolutions of the international conference in Washington.
(10) Designation for a uniformly covered sky according to the form of the clouds.
(11) Definition of rain and snow days.
(12) Should not the general adoption of a uniform height above the earth for raingauges be recommended?
(13) What progress has been made lately in the more exact measurement of snow?
(14) International meteorological tables.
(15) Modification of the rules for the administration of the International Committee.

In case you intend to submit to the Committee remarks on one or the other of these questions or to propose other questions, we request that you will please address them in good time to Mr. Robert H. Scott, (Meteorological Office, 116 Victoria street, London).

For the International Committee on Meteorology.

H. WILD, President,
R. H. SCOTT, Secretary.

WAVE MOTIONS.—The April *Pilot Chart*, published by the U. S. Hydrographic office, contains the following notice on this subject:

The ships of the U. S. Navy have been engaged for some time in making observations of the dimensions and speeds of deep sea-waves. These recorded observations are not so complete or numerous as is desired, and any assistance in this respect will do much to advance one important branch of the science of naval architecture.

The observations made where a ship falls in with a single series of approximately regular waves are most valuable, and should be accompanied by full records of the attendant circumstances.

One method of measuring the wave lengths consists in towing a log line astern of a ship and noting the length of line when the chip floats on the wave crest next abaft that on which the stern of the ship momentarily floats. The ship should be head on, or allowance made for the departure of the log line from the head on position.

To measure the wave heights, when the ship is in the trough of the sea, and for an instant upright, the observer takes up a position such that the successive average wave ridges, as viewed by him from the trough, just reach the line of the horizon without obscuring it. The height of the eye above the water level correctly measures the height of the waves. To measure very high waves the observer may have to ascend the rigging, while for waves of less height a station on one of the decks may suffice, or some temporary expedient devised for placing the observer near the water level. It is desirable to select a position as nearly amidships as possible, but if it becomes necessary to take a station near the bow or stern, allowance must be made in estimating the height of the eye above water for the deeper immersion which may be caused at the instant by pitching.

The longest recorded wave measured a half a mile from crest to crest, with a period of 23 seconds. Waves having a length of 500 or 600 feet, and periods of 10 to 11 seconds, are the ordinary storm waves of the North Atlantic.

In regard to the heights of waves, the most trustworthy measurements show from 44 to 48 feet to be a remarkable height. Waves having a greater height than 30 feet are not commonly encountered.

This Office has blank forms for recording these observations, and would be glad to furnish them to any ship-master who would take sufficient interest in the subject to make observations whenever the opportunity arises.

TO THE CRITICISMS of our note on Denison's Climatal Maps, (p. 545 of vol. I) the author replies as follows:

In the many notices these maps have elicited, there are only two objections which require explanation.

FIRST, the omission of the extreme annual ranges of temperature. One reason for this omission is that these extremes are annual spurts of temperature, which are misleading as to the essential desirability of climates. They may occur in places otherwise favorable because of their dryness and sunshine. The daily and monthly ranges are given, however, both for the seasons and the year; and these are excellent guides as to dry climates, when, as at Los Angeles, Salt Lake and Denver, there are very high daily, compared to their monthly ranges of temperature. That dryness is indicated by variability of temperature (see

author's essay on "Dryness," read before the American Climatological Association, 1884) will be evident to any one who will average the ranges of temperature for the separate belts of color on the seasonal charts. Fifty representative places, thus averaged for the annual means of daily and monthly ranges, give the following results, (see table) which show that places of *extreme dryness* are more than two and one half times as variable in daily temperature as those of *extreme moisture*. Furthermore, for each of the four divisions of climate, from the extreme of dryness to the extreme of moisture, the monthly means regularly *decrease* in variability.

TABLE.

	Means of Daily Ranges	Means of Monthly Ranges.
Extreme Dryness	36.51° Fahr.	53.65°
Moderate "	20.63°	49.38°
Moderate Moisture	17.09°	45.48°
Extreme "	13.61°	41.55°

For those who wish the annual extremes of temperature, the following rule is approximately accurate: *The extreme annual range is usually about the mean of four times the mean daily and twice the monthly ranges of temperature for equable places, and five times the daily and twice the monthly ranges for variable places.*

SECOND. A fuller explanation is desired by one critic of the method employed in obtaining the mean of combined humidities, or the average of climate. The mean of .67 for relative humidity was obtained by choosing places on different parallels of latitude, representative of the whole country, and finding their average. The mean of .44½ for cloudiness is a little less than the average for all stations for 1883. These means are only claimed to be approximate. The line between the red of dryness and the blue of moisture, may apportion a little too much of the country to moisture, but a true line for many years, instead of one, '83, which was some colder than the average, would not vary five per cent. in statistics from the mean as drawn on the seasonal charts.

We think the maps will serve a useful purpose with physicians and invalids in search of suitable climates for their patients and themselves. The maps should also make a part of the furnishings of every school.

CLIMATE OF SANTA FE.

IV. LOCAL STORMS AND SPECIAL PHENOMENA.

Afternoon rainstorms can be frequently seen in the mountains in spring and sometimes give a little rain to the city. They are sometimes accompanied by a little thunder, and May thunder is so well known as to have been incorporated in popular proverbial expressions. These cease in June, and July and August are the months for the heavy rains. The heaviest rains are from the west and southwest, and occur when the winds from the Valles or Sandia Mountains bring clouds which join those already hanging over the mountains east of Santa Fe. Lighter

storms form in, and come from, the Santa Fe Mountains, unconnected with winds from the south and west.

The thunderstorms have the same general characters as those elsewhere. When they pass over the wind ceases and the temperature falls. After they have passed the temperature remains cool and a light wind springs up, usually from some other direction than that before the storm. One or two very severe thunderstorms pass over the city each year on an average. They occur in the latter part of July and in August, when they come on in the afternoon. The lightning is very frequent and brilliant, the thunder remarkably loud and sharp, and the rolling echoes from the mountains add much to its terrors. Fatalities have been frequent from these storms, many men and horses having been killed and buildings struck. There was little safety for a man during one of them even in the streets when surrounded by buildings one and two stories high. In one case observed at the corner of the plaza, the bolt descended apparently straight on the head of the victim, and yet he was thrown six or seven feet in the air. Doubtless this was due to the return stroke, but their motion was so rapid that the direct and return stroke could not be distinguished by the observer. It has been noted that fatalities have been less frequent in the last three or four years. Judge Ellison, a resident for 38 years and an intelligent observer, says that he has known of no fatalities in the last few years, while they used to be common. The railroad reached Santa Fe, Feb. 9, 1880, and it is generally supposed that there is some connection between that event and the apparent cessation of fatalities during the severe thunderstorms.

The electric conditions of Santa Fe are remarkable. Electric disturbances are often noticeable by the simplest tests. Shocks are often experienced by touching garments of wool or cotton or on the shaking or rubbing of clothing. By a little care, sparks of considerable length can be drawn out. On Jan. 15, 1875, the Signal Service observer reported that there was an extraordinary electric storm on the telegraph line. It was first noticed at noon and lasted until 3 P. M. The natural current was so strong that the line could not be worked. The key was left open and, most of the time, was surrounded by a ring of fire. It was during the passage of a low barometer that this electric disturbance came on. Since that time the telegraph operators have noted that such disturbances are frequent and are most common from April to Octo-

ber, from 10 A. M. to 5 P. M., and frequently render the working of the line almost impossible. During these storms the strength of the current, as shown by the galvanometer, rapidly changes and its direction is frequently reversed. When the key is opened an eighth of an inch the current leaps across with a buzzing sound and an intensely brilliant flame, as large as a candle, blue or purplish in color. Paper placed in the arc is at once ignited. When the natural current is on, it makes no appreciable difference whether the battery is switched in or out. While the natural current is usually rapidly variable in strength, in direction it is occasionally steady and strong.

These electric phenomena remind one of those frequently described on Pike's Peak, where, however, they are much more remarkable. The natural currents observed by the telegraphic operator at Santa Fe are evidently the same in character as those investigated at Greenwich, England, the tracings of which, as made by automatic instruments, are reproduced in the last annual volume of the Royal Observatory. They are evidently very much stronger at Santa Fe than at Greenwich, and the former would be an excellent place to establish an electric observatory. For commercial purposes, the disturbances on the line prove very injurious. If the owners of the line would change its direction they might find these disturbances less annoying. It may also be noted that the natural currents are not likely to be so strong and annoying when more than one wire is strung on the poles.

Heavy rains in the mountains occasionally cause severe floods in the city. Santa Fe was submerged in 1853 and again in August 1854, but the heaviest of these floods since the territory was occupied by the United States was in 1858 when the city was extensively overflowed. Another occurred in September of 1859 or 1860 when a heavy rain fell just out of the city, a little above old Fort Marcy. The water poured down the arroyos over the town until it was about two feet deep on the street in front of the old palace. Another overflow resulted from a severe rain in the mountains August 9 and 10, 1883. The flood which then came down on Santa Fe is described as appalling. Waves 5 and 6 feet high came down the arroyos and swelled the Rio Santa Fe until it was impassable. It did much damage in Santa Fe and over a large extent of territory around it. Trains were delayed over a large stretch of track. Again about midnight of May 26, 1884, a

"cloud burst" reached the city from the southwest and deluged the streets. It came from the Cerillos Mountains. Santa Fe, however, does not suffer from the floods of the Rio Grande, and its washouts are always of brief duration.

Hail storms are not infrequent in the spring, but usually are light and do no damage. One on March 10, 1884, was accompanied by a high wind, took off some roofs and did other damage, the whole amounting to perhaps a thousand dollars. It seems to have been part of a general storm, as there was unusual precipitation at that time over the sources of the Rio Grande and Gila. The storm was reported very severe in Utah and Colorado, and snow fell to the depth of three feet in Tierra Amarilla, Rio Arriba county.

The city does not suffer from the sand storms and whirls, so common farther south. One must go southward 40 or 50 miles before reaching the region where they occur. I have, however, found the record of a tornado which passed over the city, the account of which I condense from the *New Mexican*. It was on the afternoon of May 12, 1883. Heavy blue and white, rain-laden clouds had hung all day about the city and dipped down into the gulches, completely hiding the mountain tops. Towards afternoon the gale from the south became furious and its accompanying dust stifling. Then it became comparatively calm for an hour or two when another furious blast set in at about 4:30 P. M. At about 5 this wind shifted to the southwest and an immense cloud of dust was seen approaching from that direction. As it came it rose higher, and in it was seen a black funnel heading directly for the plaza. It passed very quickly, causing great alarm, breaking down trees and tearing off roofs, but without injury to human beings. The total damage was about $800.

Among special phenomena observed at Santa Fe, I may note that on April 15th, 1869, at 8 P. M., a fine aurora was seen, the only display of this sort of which I have been able to learn. On August 1, 1873, there was a distinct shock of earthquake felt at 1:35 P. M. The movement was from east to west, the duration of shock six seconds. The vibrations were about three to a second.

V. CHANGE OF CLIMATE.

A possible change for Santa Fe was pointed out in discussing the thunderstorms. They are apparently not so destructive as they were formerly. It remains to be seen whether this is a fixed change or only a temporary one.

The change, however, which is anxiously looked for in all the western dry states and territories is a change in the direction of more moisture. That there has been such a change in some of them (as in Nebraska and Utah) seems to be a fact, and the citizens of New Mexico are expecting this change in their case. At the same time it is currently believed in the territory that since the Spanish settlement a change has actually occurred for the worse. The foundation for this belief is found in the evident great population which once existed in the territory. That the population was once larger cannot be doubted. The reports of the Spanish when the territory was first visited in the sixteenth century place this beyond doubt. In some parts of the territory the population has remained about constant, but in other parts it has greatly decreased. The Gran Quivira, to the east of Belen, was once a great city but has not now a single inhabitant. There are evidences of irrigation on a large scale near Fort Craig on the western side of the Rio Grande, indicating that there was once a much larger population there than there is now. In many other parts of the territory there are similar evidences of irrigation on a much larger scale than at present. Diggings also develop evidence of previous large occupation. Near where the penitentiary now stands in Santa Fe, in digging a well, an old camping spot with three stones and charcoal was found. Near Fernando de Taos, old foundations well laid in lime and mortar are found as deep as 30 feet, and in the mines the evidences are abundant of former workings on a much larger scale than would be possible with the present Indian population. The pueblos which occupied the present site of Santa Fe once extended a distance of 7 miles up and down the creek.

But it does not follow that because the population was larger that the climate was different. The territory is now only partially developed, and yet has nearly 150,000 inhabitants. It is easily capable of supporting five times that number, and this is a figure which may surpass the population there at the time of the advent of the Spanish. Indeed, the irrigation-works indicate plainly the same need of irrigation as at present. The Gran Quivira is many miles from the nearest water, and it is customary to say that so large a city would not have been built there unless the water had been abundant at the time of building. It was found well populated by the Spaniards in 1595–6, and so well fortified that they dared not attack it. They do not mention it as a place well sup-

plied with water. (It must be remembered that the word Quivira, as used by the early Spanish, referred to more than one place. The Quivira visited by Coronado and Peñalosa, and which was described as very fertile and on a great river, was only reached by a long journey across the plains. Mr. Prince, the historian of the territory, thinks this was on the Missouri River.) Traces of irrigation ditches extending 15 or 20 miles away from it indicate that it probably got its supply artificially. The decrease of the Indians does not indicate an increasing rigor in the climate, but the rigor of their Spanish masters. It is a matter of history that the inhabitants of the Gran Quivira emigrated westward in a body between 1693 and 1696. Large bodies of other Indians emigrated at the same time, some to the westward, while some joined the wandering Apaches of the plains.

At the present writing (May 1, 1885) the season is decidedly wetter than usual. This was true of the year 1884. But this is probably not a permanent change. As was pointed out while discussing the precipitation, there has been a periodic change in rainfall—each period lasting about eleven years—ever since the territory was occupied by the United States. The years 1884 and 1885 fall in the wettest part of one of these periods. Taking all the facts together no permanent change in the humidity of the territory has yet been demonstrated, since the territory was occupied by the Spanish.

Before that time a change may have occurred, but there are no proofs of it. It is only indicated by meager tradition. It is said, for instance, that the region immediately about Santa Fe was once heavily timbered, and that the timber was removed partly for fuel and partly for purposes of defence. The traditions relating to Montezuma say that he was induced to lead a part of his people southward by the increasing dryness of his territory—in all probability the region about Santa Fe and Pecos. It may be that we have here the same climatal history as in Palestine and elsewhere, as pointed out by Marsh in his "Man and Nature." It may be that this country was once well clothed with forests and had sufficient rainfall. But when we examine the general weather conditions, we see that the territory should be dry and these weather conditions can not have changed since the mountains were elevated to their present status. And when we examine the topography we find, in its raggedness and sharpness, that water was scarce in its making. The flora and fauna are also distinctly those of a dry

country, and it seems probable that no great climatal change has taken place there during the present geological age.

VI. SALUBRITY.

The best tests of the salubrity of a region are the health, the mortality, and the longevity of the people who inhabit it. Judged by these tests, Santa Fe deserves the reputation of unusual salubrity which has been given it. Although the natives pay no attention to sanitary principles (indeed they neither know nor care anything for them), and although they live on *chili colorado* (red pepper) and *tortillas*, neither of which is usually considered healthy food, yet their usual healthfulness is remarkable. Their lack of sanitary principles proves very injurious to them in the epidemics of contagious diseases to which they are no more exempt than other people. As an illustration we may mention the epidemic of small pox which was prevalent for two or three winters not long ago. The natives would not be vaccinated; they seemed to fear inoculation with other and worse diseases. They would not properly care for themselves when they came down with the disease. Worse than all, they took no pains to prevent the spread of the contagion. After the death of a small pox patient, the bedding was not destroyed, but spread in the street to air. In accordance with their funeral customs, persons, especially children, dead with small-pox, were carried through the streets by men, in the daytime when the streets were full, and with open coffin and exposed face. The natives looked on the epidemic as a visitation of Providence, which it was wicked to avoid. The result was that the disease spread fearfully among the native population, and the number of deaths from it have been estimated at 700 in Santa Fe and vicinity. The Americans, however, protected themselves by vaccination and other sanitary precautions and were comparatively free from the disease. Other contagious diseases sometimes occur and are quite fatal with the natives—as diphtheria and scarlet fever, and in the history of the territory measles has sometimes been a terrible scourge, proving fatal to a degree never known among Americans proper. Venereal diseases and their cortege are said to be too common. Aside from these, however, the native population is remarkably free from disease, and many natives pass a long life and die of old age without sickness so serious that it will not yield to their own simple remedies, without the aid of a physician.

A numerical test of this freedom from dangerous disease, inherent to the climate, is to be had in the following figures, which I owe to to a paper kindly put at my disposal by the surgeon of the army post, Dr. Alexander. From 1869 to Dec. 14, 1876, (8 years lacking 17 days) the number of deaths in the parish of Santa Fe, as given by the rector, from statistics on file at the cathedral, was 1,005. The number of parishioners during the same time varied between 7,000 and 8,000. This would give 126 deaths a year in about 7,500 people, or 16 per thousand. The parishioners are almost all in the city the remainder being in small towns within a few miles of the city. From the nature of the surrounding territory, country-people are almost unknown. These figures are therefore to be compared with the city mortality elsewhere, and this comparison shows them to be very low. Twenty per thousand is considered a low average mortality elsewhere, and 23 or 24 is considered favorable. The city of Santa Fe has only 16 per thousand notwithstanding their liability to epidemic and other diseases due to their disregard of sanitary principles, as already pointed out.

The remaining test of the salubrity of the climate, which is available in this case, is the longevity of the natives. The only practicable way of testing this is to find out the number of old people, and for this purpose I have made considerable effort, first to find out and assure myself of individual centenarians, and second to get some idea of the proportion of natives who pass the age of 80 years. The inquiry has been full of serious difficulty. Through the intervention of his excellency, Gov. Sheldon and of that of Marshal Morrison, I was given access to the death-registers at the cathedral. They proved, however to be useless for my purpose. In the case of aged people the ages were almost invariably given in round numbers with the addition "poco mas o menos," or some similar note which deprived them entirely of the accuracy desired for this purpose. Indeed the vicar-general informed me that the older natives did not know their exact ages. It is sufficient for them if they were old enough to remember the American occupation, or if they were born before or after "the eclipse," meaning that of 1806. It was only by personal inquiry, the search of newspaper files, and the persistent aid of citizens, especially Mr. Ellison, that I was able to make out the list of centenarians which follows. It is probably incomplete but great pains was taken to make it accurate. It is a remarkable showing for a small community, 3,500 in Santa Fe and perhaps as many more outside. Americans were omitted from the list.

CENTENARIANS LIVING OR RECENTLY DECEASED AT OR NEAR SANTA FE:

Augustin Bustamante, of La Cienega, 120 years old when he died five years ago. He appeared as a witness in a case concerning a land patent before the Surveyor General. His age was a matter of importance in the investigation and was found on evidence to be upwards of 114.

Maria Rael, of Santa Fe, yet living, 106 years. She was born in Madrid, but has spent the most of her life in America. She has the appearance of extreme old age, and the natives say she is at least 150. She, or rather her friends, claim that she is 133 years old, and she satisfied Mr. Ellison that she is at least 106.

Manuela Martinez, of Santa Fe, yet living, 104.

Ignacio Maes, of Las Cieneguitas, 104 years old.

Juan Miguel Maes, Las Cieneguitas, 100 years old.

This is probably not a complete list, as I heard of others, Indian and Mexican, of whom, however, I was not able to learn anything definite.

Longevity does not, of course, depend only on climate; it depends also upon race and upon habits of life. As to the effect of race, in this case, I am unable to say much—I know of no study of either the Aztec Indians nor of the Spanish as to longevity. As to habits of life, they are undoubtedly favorable in New Mexico to long life—or, rather, they have been favorable, for an intelligent native told me that since the advent of the Americans the natives did not live so long, and it is the prevalent opinion that the aged people have been dying off in unusual number in the last few years. But, even yet, the Santa Feans live slowly and deliberately. They never hurry; they do not have to labor much to keep alive; their food is never too rich; they do not trouble themselves about the problems of science or metaphysics, or even politics; they are settled in a comfortable religious faith where the priest takes on himself the care of their consciences; they are not even troubled with the labor and anxieties of excessive cleanliness. They live a slow, contented, unambitious life, sunning themselves when the sun shines and waiting for it when it does not. They have no great hardships, no anxieties, no severe labors; they are in no haste to get rich; why should they not live long? They could not live long, however, without a good climate. That is an essential factor in longevity, and that they are long-lived indicates the salubrity of their climate.

As to the proportion of people living beyond 80, careful estimates, made by several persons, native and American, who have lived here long, put the proportion to the entire native population at 50 in the thousand. I had a list made for me of people over 80 years of age, giving name and age, and this list indicates that the above ratio is not too large. This is for Santa Fe; in neighboring places the ratio does not seem to be so large. In the town of Taos, for instance, the most trustworthy estimate is 30 per thousand. These figures are decidedly more favorable than those of the mortality tables usually employed. By Dr. Farr's "English tables" for males the corresponding numbers are 16 to 18.

As to the healthfulness of Santa Fe for certain classes of invalids, the testimony is quite unaminous. Sufferers from diseases of the lungs are almost universally benefitted, and many of the active American citizens of the city at the present time went there not many years ago as invalids, sometimes far advanced. As to the causes of the curative properties of the climate, it is generally agreed on by physicians, and is set down by Dr Bartholow in the two words "dryness and elevation." These Santa Fe has to an unusual degree, and, in fact in consequence of them, it has another feature or two welcome to invalids. It is a very sunny place and the temperature is mild. The invalid is thus led to be out in the open air a great deal. It also has a moderate temperature and the nights are always so cool as to promote sound and refreshing sleep. To these may be added some attractions not so physical. The scenery is picturesque but of an entirely different order from that seen in other parts of the world. It has much grandeur but its beauty is of an odd and unique character; it has an element which reminds one of some of Dante's descriptions, and could, somewhat properly, be described as infernal. Its novelty does not easily wear off and persons palled with the White Mountains, the Alleghanies, and even the Alps, would have renewed and sustained interest in the aspects of nature in New Mexico. The points of interest about Santa Fe are very numerous, existing and ruined pueblos, cliff-dwellings, the mines, the mineral springs, varied mountain scenery within easy reach; the social conditions are picturesque presenting an ever-varied panorama of Indian wrapped in his red blanket, Mexican with his burro, African transplanted and developing some of his quaintest types, Americans of all types from the Californian to the Tennessean or down-

east Yankee; the architecture, the Spanish forms of faith transplanted to the United States, and taking, after being grafted on native stock, peculiar and instructive forms, the innumerable historical associations in which Santa Fe is remarkably rich; all these tend to wean the invalid from his sufferings and promote his recovery.

The climate of Santa Fe has many analogies to better known climates elsewhere. The dryness, the dust and the alkalinity of the soil remind one of the climate of the great city of Peking, where, notwithstanding the positive disregard of all sanitary laws, the healthfulness is remarkable. The analogy extends to everything but the elevation; Peking is not far above sea-level. The City of Mexico presents a closer analogy in elevation and surroundings, and it is interesting to note that this city is also noted for its curative climate for lung diseases. Consumption is almost unknown among the residents, and many Mexicans from other parts of the republic are cured on making a long stay in the capital. But perhaps the closest analogy of all is to be found in Old Spain, and especially in some of the health-resorts of the Pyrenees. They are perhaps the best health-resorts in all Europe, and their capacity for curing has been known for many centuries.

Santa Fe is not, however, a favorable residence for invalids of all classes. In the hospital-records at the army post, we find uniformly rheumatism and catarrh recorded as prevalent diseases, and it is generally acknowledged that rheumatic patients are rather injured than benefitted by a residence there. And, although the manifold novelties in nature and society there would afford beneficial distraction to the person who is nervous from either too much or too little work, yet the dryness and rarity of the atmosphere would be likely to be deleterious to those nervous patients whose disease is more deeply seated.

The accommodations for invalids are ample. The hotel accommodations are unusually large and St. Vincent's Hospital will accommodate many patients. The latter is the proper sanitarium of Santa Fe. It is very complete and comfortable in all its appointments, and its sanitary condition is most excellent. Though under the control of a branch of the Sisters of Charity, there is nothing in its management to which a protestant can object.

M. W. HARRINGTON.

WEATHER CHANGES OF LONG PERIOD.

In a letter written near the middle of March, which was published in the April number of this JOURNAL, I pointed out from a mere inspection of the Signal Service daily weather maps that there was in progress a movement of an area of cold weather across the country, which had occupied two months in its movement from Montana to the Lake Region. I am glad now to be able to demonstrate my position by means of charts prepared by the Signal Service; for, fortunately for my purpose, the Signal Service began last August the publication of charts showing each month how much the temperature and pressure in all parts of the United States differed from the average of that month obtained from a number of years, in other words charts showing the "departure from normal."

The first six charts accompanying this article show the departure from the normal temperature for each month from December to May, the lines for every 4° F. being copied as exactly as possible from the charts as given in the *Monthly Weather Review;* except the last two which were constructed from data furnished by the Signal Office, the *Weather Review* for these months not having been issued.

It will be seen that in December there was an area in the Northern Rocky Mountain Slope where the temperature was 20° lower than the average. In January the area of greatest cold is found in the vicinity of the Mississippi. The cold was not so intense as in December, but there was a large area inclosed in the line of −8°, within which the temperature was from 8° to nearly 12° below the normal. An area where the temperature is above the normal is seen to be just entering on the Pacific coast. In February the area of greatest cold, increased in intensity, is found in the Lake Region; while the area of warmth is seen to be central in the North Pacific coast region, the line separating the places where the temperature was above from the places where it was below normal, having advanced about 12° of longitude toward the east since January. The area of cold thus seems to have moved directly toward the east at the rate of about 12° of longitude a month. In March the direction of motion seems to have slightly changed, the area of cold being found to the northeast of its posi-

tion in February. The line of no variation has moved about 10° of longitude toward the east, and the area of greatest abnormal warmth is found to the east of its former position. In April these movements are found to have continued, but the departures have greatly decreased in intensity, The line of no variation is seen to be considerably east of its position in March, especially in the southern United States where the change has been very decided.

In May, the area of cold, instead of continuing its movement toward the east, is found to have remained almost stationary, but increased in intensity and very much in area, thus pushing the line of no variation on one side back toward the west, and on the other toward the east. This was chiefly due to a phenomenon which shall subsequently be referred to as taking place independent of movements from west to east.

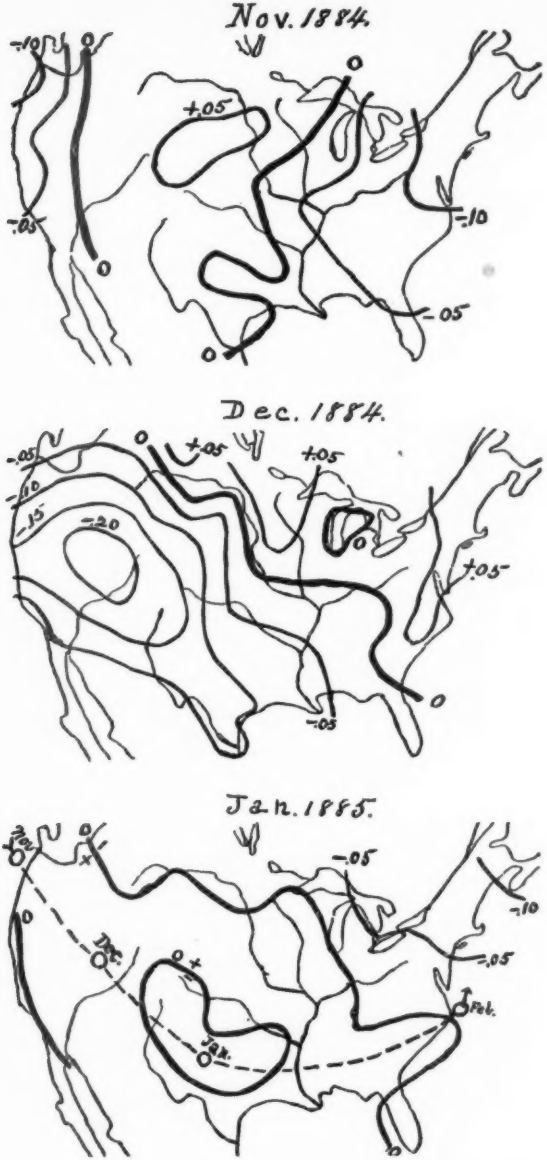
A study of the departures from normal pressure renders it evident that there was an eastward movement of the pressure departures similar to those of the temperature.

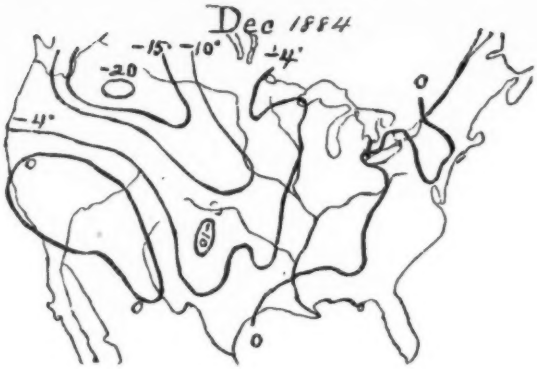
The second series of maps accompanying this article give the lines copied as exactly as possible from the Signal Service charts, showing the departures from the normal pressure over the United States for each month from last November to April.

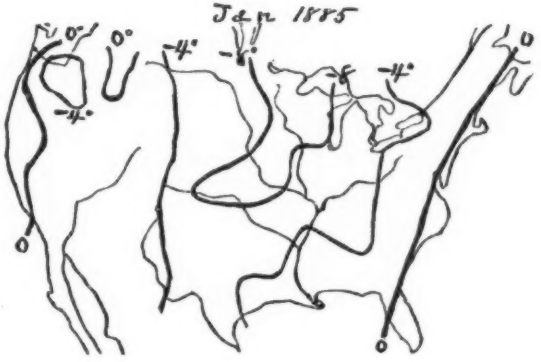
The chart for November shows that there was an area near the Atlantic coast, and another near the North Pacific coast, where the pressure was more than a tenth of an inch below the normal; while there was an area of higher pressure between them, with the greatest departures in the Missouri Valley and middle Rocky Mountain Slope. The area of highest abnormal pressure for October was found in the southern Rocky Mountain Slope, and was consequently moving in a northerly direction.

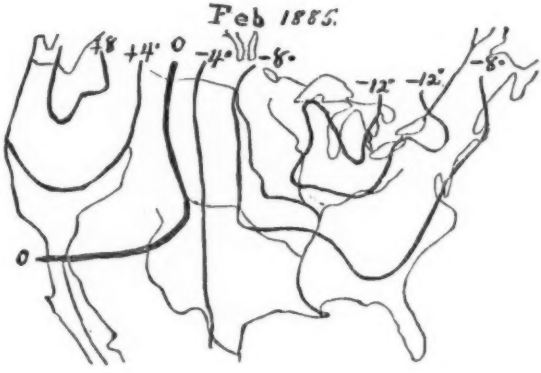
In December the area of abnormally high pressure is found off to the northeast of its position in November; and in the whole southwestern half of the United States the pressure is decidedly below normal, with the area of greatest departure to the southeast of its position in November. A small area where the pressure was slightly below the normal is also found in the Lake Region.

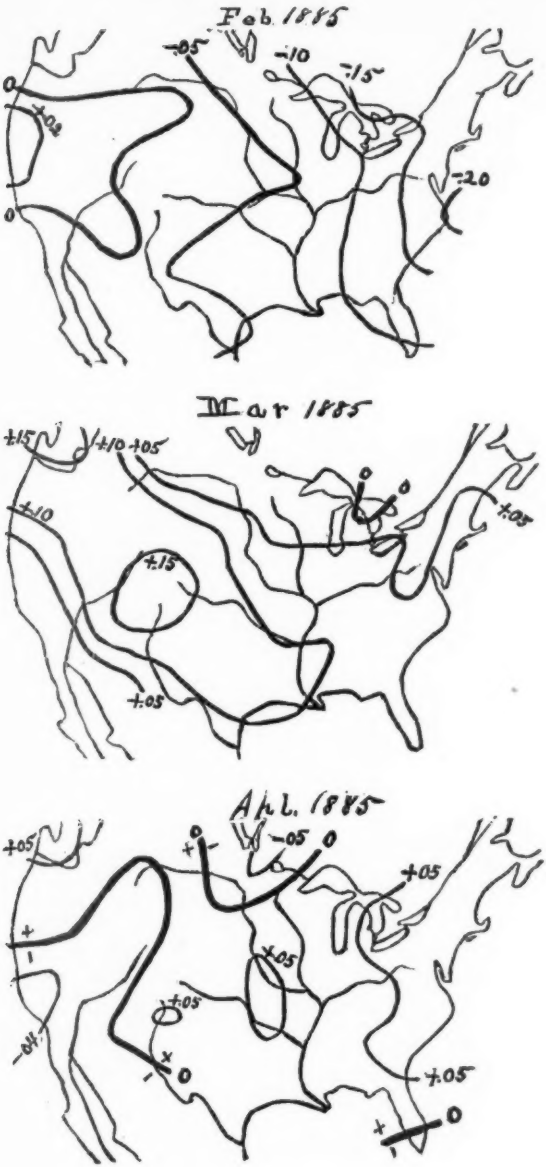
In January an area where the pressure was considerably below normal is found in the vicinity of Nova Scotia. This was, no doubt, connected with the small area central in the Lake Region in December. The pressure was slightly above the normal over most of the United States; but, on inspecting the tables accom-


Nov. 1884.
-.10
0
+.05
-.05
0
-.10
-.05
0
Dec. 1884.
-.05
0
+.05
+.05
-.10
-.15
-.20
+.05
0
-.05
Jan. 1885.
-.05
-.10
-.05
Jan.
Dec.
Feb.


Dec 1884
-15°
-10°
-4°
-20
-4°
0
0
0
0


Jan 1885
0°
0°
-4°
-4°
-4°
-4°
0
0
0


Feb 1885.
+8
+4°
0
-4°
-8°
-12°
-12°
-8°
0


Feb. 1885
-.05
-.10
-.15
0
+.05
0
-.20
Mar 1885
+.15
+.10
+.05
+.10
+.15
0
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Apl. 1885
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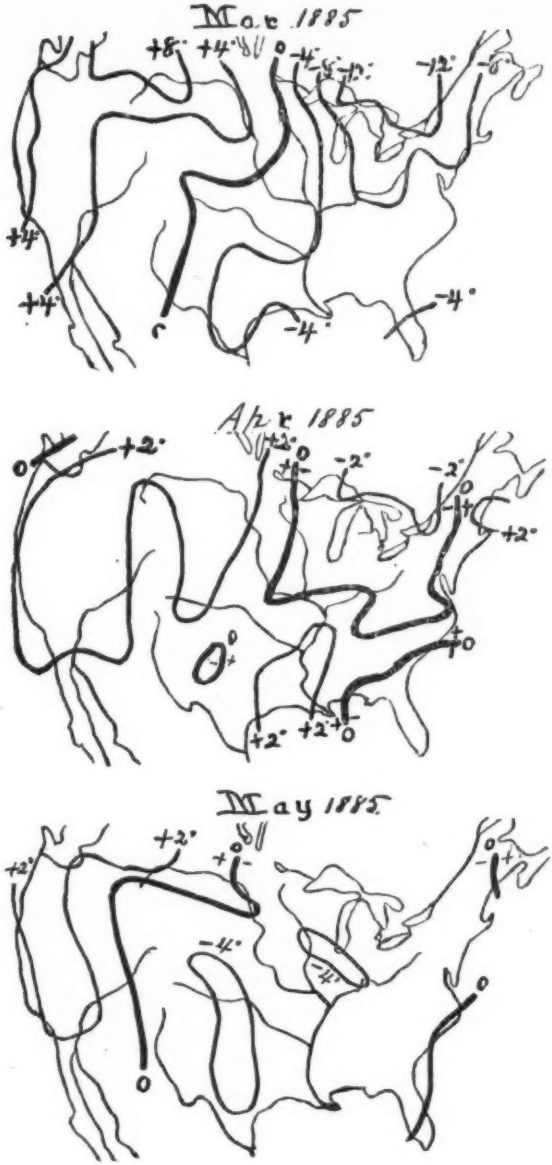
0
+.05
+.05
+.05
+.05
0
+.05
0


March 1885
April 1885
May 1885

panying the January *Weather Review*, it is found that the pressure at Denver was normal, and at Los Animas, Palestine and Fort Smith, slightly below. No line was drawn around this region by the Signal Service, and when written to on the subject it was replied;--"As the means at all surrounding stations were above the normal, the departures at Palestine and Fort Smith appeared questionable, and no consideration was given them in drawing the lines."—The departures below the normal were found to be nearly as great at the stations mentioned as they were above at surrounding stations, and I see no reason to conclude that they were in error. I have consequently drawn a line of no variation around this region, separating the places where the pressure was reported above, from the places where it was reported below the normal. A slight area of abnormal depression is thus found to the southeast of the great depression of December.

In February a great abnormal depression is found just off the Atlantic coast.

The departures from the normal of the means of the thirty days from January 15 to February 14 were computed for about twenty widely separated stations, and these showed that the area of greatest minus departure was in the vicinity of Tennessee—or midway between the abnormal depressions found in January and February.

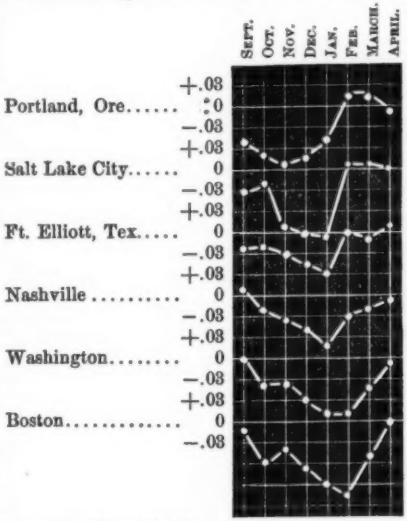
There can hardly be a doubt that all of these were one and the same depression moving slowly across the continent from west to east. A dotted line is drawn on the January chart which is supposed to represent the path pursued by the center of the depression.

In February an area of high pressure is found just entering on the Pacific coast. In March it was central in the Rocky Mountain Region, and covered nearly the whole country. In April it had moved eastward, but still covered nearly the whole of the United States, depressions being found on the Pacific coast and in the Northwest*

The charts seem to prove beyond doubt that a great barometric depression of slow movement followed by a barometric elevation, passed over the continent from west to east, and it hardly seems

* In May this latter depression is found to have increased in intensity and moved into the Lake Region with the greatest departures —.087″ and —.088″ at Marquette and Escanaba. A new depression also appeared off the Atlantic coast. These caused the area of high pressure to be divided in two, one of which remained west of the Mississippi, and the other is found within and to the north of New England.

necessary to seek farther evidence; but that no method might be untried by which this conclusion might be tested or strengthened, curves were constructed from the averages of every three consecutive monthly departures, as reported from a number of stations at distances of every few hundred miles along the track supposed to have been followed by the depression. These curves are given in the diagram, and show as did the charts that a great barometric depression passed the Pacific coast in November, the Rocky Mountains in December, the central United States in January* and the Atlantic coast in February. The curves also show that the depression was so great as to override all other influences of any considerable duration.



I now especially desire to call attention to the fact that the abnormal depression increased very much in intensity in December, decreased and almost died out in January, increased again in February, and apparently decreased in March (with a corresponding increase of the abnormally high pressure), thus going through an oscillation in intensity every two months. This was due to a phenomenon to which I have already called attention in this JOURNAL under the names of barometric oscillations and cycles; but shall now call barometric *surging*, a name suggested by the writings of Hon. Ralph Abercromby. This is a phenomenon which can to a great extent be overlooked in tracing barometric movements of short period, but becomes of great importance in barometric changes of long period.

Comparing the two sets of charts together it is seen that in December the area of greatest cold is found to the north of the great abnormal barometric depression; and to the south of the

* Neither Ft. Elliott or Nashville are stations at which there was supposed to be any question as to the accuracy of the means reported in January.

abnormal high pressure, which, having now entered British America, no doubt produced an abnormal flow of air southward which caused the temperature over the whole central part of the United States to be below the normal.

In January the area of greatest cold is found to the north of the abnormal depression central in the southern Rocky Mountain Slope, and to the rear of the depression central near Nova Scotia.

In February the area of greatest cold is to the northwest of the greatest abnormal barometric depression; and the area of greatest abnormal warmth to the north of the abnormal high pressure.

In March the area of cold was to the rear of the depression and in front of the high pressure; and the area of warmth was within, and to the north of, the area of high pressure.

In April the area of greatest abnormal warmth was to the rear of the high pressure, and in front of the abnormal depression entering from the Pacific.

It is thus seen that temperature departures are related to barometric changes of long period just as they are to those of short period.

The precipitation table, published in the December *Monthly Weather Review*, shows that the precipitation was above the normal in every district of the United States except the Rio Grande Valley and North Pacific Coast Region.

In January it is found that over nearly the entire eastern half of the United States the precipitation was above the normal, while over nearly the entire western half it was below. During the entire three months, from February to April, comparatively few districts had precipitation above the normal, and in some the deficiencies were very great.

It is thus seen that in front of and within this great abnormal depression of long period the precipitation was above the normal, while in its rear—in front of and within the area of abnormal high pressure—the precipitation was below the normal, thus showing an exact analogy to what occurs in connection with barometric changes of short period.

In January and February the snowfall was very large to the north of the long period depression, again showing an exact analogy to the depression of short period.

The severity of the past winter was probably due to the fact

that the depression was more intense and went farther south than is usual for depressions of long period.

With the same facilities as at present, I am satisfied I could have given equally as good evidence of the movements of long period weather areas in 1880. In the winter and spring of that year I discovered with meagre data what seemed to be a slow eastward movement of an area of cold. The idea was then a novel one to me, and after following it for a month or two, I laid the data aside, determined to give it a thorough investigation as soon as I had completed a line of investigation in which I was then engaged.* In 1882, I came across Mr. Fred. Chambers' article, in *Nature*, vol. 23, Nos. 4 and 5. In this article, after giving curves constructed from barometric means obtained from widely separated tropical stations such as St. Helena, Mauritius, Calcutta and Batavia, Mr. Chambers remarks.—"The general resemblance of these curves to each other is very remarkable * * *. It will be seen, however, that there is strong evidence of a want of exact simultaneity in the barometric movements at different stations, and that as a rule the changes take place at the more westerly stations *several months earlier* than at the more easterly ones. * * * *It appears then that these long atmospheric waves (if such they may be called) travel at a very slow and variable rate around the earth from west to east, like the cyclones of the extra tropical latitudes.*"

It is hardly necessary to say I read this with the deepest interest and returned at once to the investigation I had postponed. After working for several months, however, I became convinced that there were changes or oscillations in the pressure and other elements in the United States which were distinct from motions of translation. I toiled continuously for two years and a half in the endeavor to gain a clearer understanding of these. A part of the results of my labors were published in this JOURNAL, vol. I, Nos. 4 and 12, and vol. II, No. 2.† In the mean time there appeared an article in *Nature*, vol 28, Nos. 15 and 16, (August '83) by A. N. Pearson, Acg. Met. Reporter for Western India, in which the writer gave evidence to show that there had been during the time from 1880–82 barometric changes occupying several months in their movement from Northern Africa across Southern Asia,

* I was carrying on an investigation to ascertain if there were weather cycles related to planetary movements as had been asserted.

† Hon. Ralph Abercromby in his *Principles of Weather Forecasting*, pp. 33-34, just issued, gives a short article on certain barometric changes of short period which partially represents the idea at which I h d arrived. He calls the phenomenon *Surging;* a name which I shall adopt, and use instead of "cycle," since it seems more appropriate.

and besides that there had been simultaneous barometric changes over this area. There also appeared an article by Mr. L. A. Sherman in vol. I, No 7 (November '84) of this JOURNAL, in which he stated that he had traced weather areas in the United States which had occupied several weeks in their movements from the Rocky Mountain Region to the Lakes or to the Atlantic coast.

During the present winter, an inspection of the weather maps showed me that a marked instance of the eastward movement of an area of cold weather of long period was in progress; and in a letter written about the middle of March (referred to at the beginning of this article), after pointing out this movement and that an area of warmth had appeared in the extreme west, I added—"May we not hope that this like the area of cold will sweep over the country, and give us a pleasant spring after our long winter?"

An inspection of the charts will show that by the end of March fully half of the country had been covered by the area of warmth, and by the end of April fully three-fourths. My surmise was certainly then 75 per cent. verified. In the May JOURNAL I attempted to tell exactly where the area of warmth would be found for that month. This proved a failure; but I am confident that the failure was caused by lack of data, and lack of time to work up what data I had, which consisted almost entirely of incomplete Signal Service returns obtained from the newspapers. The last Signal Service charts I had were those for February. Had I had the charts for April and seen that a new barometric depression had appeared in the Northwest,* accompanied by greatly decreased temperature departures, and time and data to have ascertained that a certain *surge* was greatly increasing in intensity, which might easily have been done, my prediction would undoubtedly have been altered.

Besides these general predictions more detailed predictions were also begun in the letter referred to. I stated that "if I should hazard a guess as to the coming weather in the Lake Region, I should say—a period of considerable warmth during the first part of April, a cooler period about the 15th to the 20th, and warm again during the first part of May." The first period was completely fulfilled; the cooler period began rather earlier than was expected, but extended nearly through the period given; the prediction for the third period was a complete failure.

The June JOURNAL contained the following for the part of the

* The part of the United States bordering on Manitoba.

United States east of the Mississippi River: "It is probable that between the 1st and 10th of June the period of high pressure which prevailed during the middle and latter part of May will be replaced by lower pressure and cooler cloudy weather, followed in turn by a period of higher pressure and warmer weather between the 15th and 25th. The remaining parts of the month will probably be nearer normal."

The five day means* in the accompanying table from May 1 to June 19 at four widely separated stations will show how completely the prediction has so far been fulfilled in regard to the atmospheric pressure.

FIVE DAY BAROMETRIC MEANS.

	Boston.	Washington.	Chicago.	Nashville.
May 1- 5..	29.89	29.90	29.87	29.91
" 6-10..	29.88	29.89	29.78	29.89
" 11-15..	30.09	30.13	30.05	30.05
" 16-20..	30.00	30.00	29.94	29.92
" 21-25..	30.12	30.06	29.90	29.95
" 26-30..	30.00	30.01	29.86	29.84
June 31- 4..	29.81	29.91	29.84	29.92
" 5- 9..	29.82	29.96	29.86	29.89
" 10-14..	30.09	30.14	29.96	30.04
" 15-19..	30.01	30.11	30.07	30.11

The prediction in regard to temperature was not fulfilled, however, over the entire section of country east of the Mississippi. To the west of a line running just east of Chicago and to the east of Nashville the mean temperature from the 1st to the 10th of June was higher than for any corresponding interval in May, but to the east of this line lower. The mean temperature at Ann Arbor from May 17–26 was 63°.1; and from June 1–10, 62°.3. For eastern stations, only the observations at 11 P. M. of each day are accessible. The accompanying table shows the means of these at several stations from May 18–27, as compared with the means from June 1–10. Data in regard to cloudiness are not accessible.

MEAN TEMPERATURES.

	May 18-27.	June 1-10.
Boston.....	57.9°	56.9°
Albany.....	62.6°	58.5°
Washington..	66.7°	65.6°

Thus out of four periods of short duration for which it was predicted that the temperature would rise above or fall below a preceding period, three were completely, or in large part, fulfilled over the

* For Boston and Washington the means were obtained from the 11 P. M. observation of each day, no other reports being accessible after June 1.

area predicted for, and only one was a complete failure; while all predictions in regard to pressure have so far been completely fulfilled.

This is the most powerful argument I can offer that the predictions were based on the *facts* of nature.

When it is known that in accomplishing this I had, unassisted, to deal with a vast amount of data which at best was incomplete (being obtained in large part from the newspapers), and that I had to divide my time between investigating new facts and attempting to apply those already discovered, it does not seem impracticable to believe that with more complete data, and the greater facilities which capital can afford, general weather predictions for long periods in advance could be made with decided success.

SUMMARY.

I think, then, I have demonstrated that:—

1. There are areas of barometric depression, and elevation, which occupy weeks and months in their movements across the continent from west to east.

2. There exist, independent of the movements of areas of barometric depression, and elevation, numerous see-saw oscillations in the pressure which have been given the name of *surges*.

3. In front of, and to the south of, areas of barometric depression of slow movement and long duration, as in those of rapid movement and short duration, the temperature is above the normal; and below the normal north of them and in their rear—which is usually the front of barometric elevations. In front of, and to the south of, areas of barometric elevation of long period, as in those of short period, the temperature is below the normal, and above north of them and in their rear—which is usually the front of depressions. (In winter the area of warmth approaches and usually includes the area of lowest pressure, and the area of cold approaches and usually includes the area of highest pressure; in summer, *vice versa*.)

4. In front of, and within, barometric depressions of long period, as in those of short, the rainfall is above the normal, and below, in their rear. In front of, and within, barometric elevations of long period, as in those of short, the general tendency is toward fair and clear weather with deficient rainfall.

5. General weather predictions for long periods in advance are now practicable.

H. Helm Clayton.

Ann Arbor, Mich., June 20, 1885.

LITERARY NOTES.

Ciel et Terre. Revue populaire d'astronomie, de météorologie et de physique de globe, paraissant le 1er et le 15 de chaque mois; 8vo; Brussels; Nos. 1–7; March 1st to June 1st, 1885.

(43) A. VON DANCKELMAN: *Le Climat du Congo et son influence sur l'homme;* pp. 6–13, 32–41. Herr v. Danckelman's studies on the climate of the west coast of Africa have deservedly attracted a great deal of attention. These articles are the substance of a lecture delivered at Hamburg.

(44) C. DE ROCQUIGNY: *Les préférences de la foudre;* pp. 18–20. Lightning strikes, in preference, points standing out in the lowlands—a fact also noted at Geneva, where the upper city is free from strokes. It also exempts the beech and strikes the poplar most often. The comparative immunity of the beech is well known and still remains to be explained. The author's observations were made near Calais on a region of about 10 kilometres squared, and have extended through about 15 years.

(45) E. LAGRANGE: Pp. 25–32. A discussion of the Spanish earthquakes.

(46) A. LANCASTER furnishes the journal with a monthly review of the weather.

(47) *Les organismes vivants de l'air des hautes altitudes;* pp. 58–61. A review of the work of the Swiss scientist, E. de Freudenreich, on minute organisms at great elevations. He finds that these bodies grow less and less abundant with the elevation, and that at 2700 metres (8588 feet) they altogether disappear in the Alps. This is due to the progressive disappearance of their places of production and to the greater rarity of the air, and consequent less capacity to sustain them.

(48) *Le simoum et les trombes de sables au Bélouchistan;* pp. 80–87. From the *Quarterly Journal of the Royal Meteorological Society.*

(49) *Les tremblements de terre au Japon;* pp. 97–99. The Japanese earthquakes drawn from the Transactions of the Japanese Seismological Society.

(50) *Les Tornadoes;* pp. 100 103. A discussion of the Signal Service studies of the destructive forces involved, as drawn out by the *American Building News.*

(51) E. LAGRANGE. *La valeurs des prévisions météorologiques au point de vue pratique;* pp. 103–106. An abstract of Köppen's study, already noticed in this JOURNAL.

(52) *La foudre et ses effets sur les lignes télégraphiques et téléphoniques;* pp. 106–111. The effects of lightning on telegraphs and telephones is so important that annual reports should be published by the states or companies. This was done for 1883 by the French minister of post offices and telegraphs, and, for the same year, in Switzerland, by the telegraph-inspector. This article is an abstract of the latter. It contains much of interest, and we note only, as of practical importance, that telegraph-poles impregnated with salts are much more likely to be struck than others, and that the lines on low grounds are much the most liable to a stroke.

(53) *Fréquence relative des tempêtes dans l'hémisphere nord;* pp. 127–131. An account of Mr. Finley's excellent paper and maps on relative storm frequency.

(54) C. L.: *Quelques mots sur la météorologie des hautes régions de l'air;* pp. 131–138. Some results of observations on elevated stations. 1. The air is much purer—that is, more free from minute solid bodies. 2. These solid bodies exist, however, at the greatest altitudes. 3. The direct radiation from the sun and

moon are more sensible. 4. The meteorological phenomena have different times and different courses at the elevated stations from those below.

(55) J. VINCENT: *Les saints de glace;* pp. 145–151; with 6 maps. The days near the middle of May—10th to 14th—are likely to be cold, and the saints of those days are popularly called ice-saints. M. Vincent traces this cool period to the position of the centers of barometric pressure. For central Europe the maximum must, at that time, be over Scotland or the North Sea and the minimum to the east or southeast.

(56) W. SPRING and L. ROLAND: *Sur la poussiere organique de l'air de la ville de Liége;* pp. 151–154. The authors have found the minute particles of dust very abundant, and have shown that they contain considerable organic matter. They think that matters brought down by snow should be generally investigated.

(57) J. CHAVANNE: *Les conditions climatériques du bas Congo pendant la saison sèche;* pp. 155–162. One of the numerous, valuable contributions recently made to our knowledge of African meteorology. It contains several diagrams of the progress of the meteorological elements at Boma—one for the daily change of the dry and wet bulb thermometers, and one for the barometer, both of these for May, 1884; also the hourly change of the psychrometer for May 7 and for July 3 of the same year. H.

Das Wetter. Meteorologische Monatsschrift für Gebildete aller Stände, herausgegeben von Dr. R. Assmann, Vorsteher der Wetterwarte zu Magdeburg; vol. ii, Nos. 3–5; March to May, 1885.

(58) R. ASSMANN: Die Temperaturvertheilung an und auf dem Thüringerwalde im Januar, 1885; pp. 41–51. This is a study of the winter increase of temperature with the elevation, and leads the author to the following results: 1. The increase of temperature can, under favorable circumstances, reach notable values, in this case as much as 2°.5 C. to each 100 metres of elevation (1.°4 F for each 100 feet). 2. This phenomenon takes place when a high pressure lies east of the Thuringian Forest, the wind is slight at the lower station, and the ground is covered with snow. 3. The phenomenon was most marked when the sky was clear at night at both stations, but the lower was immersed in fog, and when an open, free surface permitted full nocturnal radiation.

(59) R. H. SCOTT: Ueber die Geschichte der Thermometer; pp. 61–65. From the *Quarterly Journal of the Royal Meteorological Society.*

(60) W. HOSSFELD: Temperatur-Beobachtungen in Kranichfeld innerhalb der untersten Luftschicht von 2 m. Höhe, und der obersten Erdschicht von 2 m. Tiefe in den Jahren 1882, 1883 und 1884; pp. 66–69. The ground temperature to a depth of 3 or 4 feet must have a notable influence on the plants rooted in the soil. This paper is a study of the answer to the question: How is the ground-temperature influenced by the air-temperature? The article is an excellent study of the subject, but so condensed that it deserves rather translation than an attempt at abstracting.

(61) KIESSLING. Ueber die geographische Verbreitung des Bishop'schen Sonnenringes; pp. 81–89. By Bishop's ring Professor Kiessling means the reddish ring so frequently noted during the last year. It is named after the observer (Bishop of Honolulu) who first noted it (Sept. 5, 1883). This is classed as one of the Krakatoa phenomena.

(62) H. HEGYFOKY. Zur Temperatur der Eismänner. The temperature anomaly of May—on the days of the saints called ice-saints—is not so distinctly marked at Budapest.

This journal contains also a monthly weather-review, crop-notes, reports from various scientific societies and many original notes of interest. H.

School of Mines Quarterly. Published for the Alumni Association, the Engineering and Chemical Societies of the School of Mines, Columbia College, New York, vol. vi, No. 4, May 1885.

(63) L. P. GRATACAP: Chlorides in Rainfall of 1884, pp. 335–338. The observations were made on Staten Island, in a place slightly sheltered by hills, four miles from the sea-shore. The form of chloride was common salt, and doubtless came from the sea. Thirty two rains were investigated during 1884. They gave a yearly average for the chlorine of 0.228 grains per gallon of rain, for salt 0.376 grains. The rainfall at Central Park was 52¼ inches; if it was the same at Staten Island, they must then get 76.24 avoirdupois pounds per acre—or 46.23 pounds of chlorine. This is somewhat more than was found at Caen, where the amount was placed at 40 pounds of common salt; of course the amount decreases as the distance from the ocean increases. H.

The Sanitarian, Monthly, New York, A. N. Bell, A. M., M. D., Editor, vol. xiv, No. 186, May 1885.

(64) R. HARVEY REED, Climatic changes in Ohio from the Destruction of Forests and Drainage and its Effects on the Health of the People, pp. 409–429. Dr. Reed, secretary of the Ohio State Sanitary Association, has drawn from his statistical studies the conclusions that denudation of trees gives more rain, wind, humidity, dust, sudden changes and harder rainfalls; and that this with the improved drainage causes floods, increases evaporation, and lessens the supply of springs and wells. In health, there is less malarial disease, but more typhoid fever and catarrh with its consequences, and also a more free spread of all contagious and zymotic diseases. Dr. Reed's results are not in entire accord with those of his predecessors, though the variation is not great.

(65) **Meteorologische Zeitschrift.** Redigirt von Dr. W. Köppen. März–April, 1885.

KRANKENHAGEN: Ueber den Einfluss der barometrischen Minima und Maxima auf das Wetter in Swinemünde, 1876–1883; 81–99. A study of the control exerted by cyclones and anticyclones on the local weather of Swinemünde according to the distance and direction of the station from the centre of low or high pressure. This is in the same line of investigation as that followed by Köppen for St. Petersburg (Wild's Repert., iv), van Bebber for North Germany (Archiv. der deutsch. Seewarte, v), Hildebrandsson for Upsala (see abstract in this JOURNAL, i), and it is clearly a method of generalization destined to find a wide use. The material for study in this paper comes from 2876 daily (8 A. M.) synoptic charts issued by the German *Seewarte* from 1876 to 1883, inclusive. The different elements of the weather are considered in much detail and from many points of view; we can here quote only a few summaries: Mean angular deviation of wind from a line of gradient (that is, the complement of the "inclination" from a circular path around the storm centre):

Gradient.....	N.	NE.	E.	SE.	S.	SW.	W.	NW.
Cyclone.....	73	64	75	80	64	66	63	68
Anticyl.....	73	68	73	74	63	64	48	48

This confirms previous results for Europe in showing a larger deviation in the rear than in the front of cyclones; Loomis' results show the opposite relation to hold for this country. The wind velocity is also greater in the rear than in the front of cyclones, but as the result is given in Beaufort scale, it cannot claim precision. In cyclones, the temperature falls below the mean when west of the centre in summer, but when north of the centre in winter; the western side of anticyclones is cool in summer, and the northeastern side in winter. Cyclones give five times as much rain as anticyclones; in the former, the rain is west of the centre; in the latter, southwest. Thunderstorms are nearly three times as common in cyclones as in anticyclones, and in the former they generally occur to the east or southeast of the low pressure centre. Cloudiness is greatest in cyclone centres, and next in their north or northwest octants. Fog is commonest in anticylones.

DE TASTES: Das Gewitter vom 1. Februar, 1884, in Tours; 114–118 (translated from Ann Soc. Mét. France). A heavy thunderstorm passed over Tours on Feb. 1, 1884; it seemed to form on the spot, the clouds hung low, and at one time developed some incipient funnel clouds; besides the loud thunder that accompanied it, ball-lightning was seen close to the ground in three parts of the city. The balls were of dark red color and of moderate size, estimated to equal a hen's egg or a child's head; they moved rapidly and disappeared without noise in two cases, and with only a slight humming.

L. WEBER: Ueber den gegenwärtigen Stand der Kugelblitz-Frage; 118–125. Quotes descriptions of several lightning balls, and refers to many others, which all agree in showing a considerable duration of the phenomena, even over a minute; a relatively slow motion like the flight of a bird; and a round or oval form. Lightning flashes generally precede, accompany or follow the appearance of the balls. Although their existence has been doubted, and the descriptions have been considered erroneous, the author accepts them as correct, especially in view of the experiments with batteries of as many as 1600 elements, having a motive force at the moment of discharge of about 4,000 Volts, by Planté (*Comptes rendus*, lxxx, 1875, p. 1135; xcix, 1884), who concludes that ball-lightning is a slow and partial discharge from a very strongly electrical cloud at a small distance from the earth. Weber adds that the cloud from which the ball comes is probably heavily charged with electricity of low tension, but he comes to no satisfactory supposition as to what the ball itself is.

—Die Windverhältnisse des Atlantischen Oceans; 126–138. This is in two parts: the second being an abstract of an article in this JOURNAL (i, 48); the first being chapter two of the "Segelhandbuch für den Atlantischen Ocean" (Hamburg, 1885), illustrated by two remarkable charts, which give certainly the best view yet presented of the winter and summer atmospheric circulation of this large area; mean direction, constancy and velocity all being indicated. The text describes the preparation of the charts, and presents a geographic subdivision of the ocean, according to the peculiarities of its winds. The change of the winter belt of tropical high pressure to the summer anticyclonic centre, about lat. 30–35, affords a fine illustration of the effect produced on the general "planetary" winds by the summer conditions of continental masses. According to a review in the *Zeitschrift* (p. 151) the "Segelhandbuch" contains nine chapters on meteorological topics.

F. TRAUMÜLLER: Die trockenen Nebel, Dämmerungen und vulkanischen Ausbrüche des Jahres 1783; 138–140. Recounts the history of the great eruptions in Iceland a century ago, and the hazy skies and brilliant twilights that followed.

ZÖPPRITZ: Excessiver Regenfall; 141. Note on a rainfall of 176^{mm}. in 23 hours, half of this amount falling in 3 hours, at Aschenberg, near Neukirch, northeastern Prussia.

KREMSER: Optischer Beobachtungen von der Schneekoppe; 141–142. The brown-reddish ring around the sun, that is seldom and but faintly seen at Berlin, appeared in great distinctness; its outer radius was 16–17°; the radius of the interior glowing disc was about 11°.

C. BÖRGEN: Die alte Frage nach dem offenen Polarmeer; 145–149.

W. M. D.

(66) **J. Eliot.** Condensation theory of the generation of cyclones. Journ. Asiatic Soc., Bengal, liii, pt. 2, 1884. The transformation of the potential energy of water vapor into heat, the consequent expansion of the air, and formation of barometric gradients on which gravity can act effectively to produce storm winds, has been regarded by Reye, Loomis, Blanford, and others, as an important process in the generation of cyclones. Professor Eliot presents in this paper some valuable studies in the same

direction. "The first and most striking feature of these cyclones was that a vast amount of kinetic energy or motion was rapidly given to a large mass of air, which previously to that action was in an almost quiescent state. * * * The transformation from the state of approximate quiescence to that of violent cyclonic motion in the bay (of Bengal) is consequently a continuous process, the successive stages of which can be fully traced. And the entire development of these and of all storms in the Bay of Bengal appears to be due to actions occurring over the bay itself, and not to atmospheric conditions at a considerable distance from the arc of cyclonic disturbance." He further points out that the heavy rain condensing and falling in a cyclone gives out its vapor energy much more rapidly than it was taken in during the deliberate process of evaporation; and that the heat thus evolved would correspond to that received from a sun 250 times as powerful as ours, acting directly on the air from which the rain falls, instead of chiefly by convection from the land or sea surface below. "Experience has established that the larger the cyclone, the smaller are antecedent differences of pressure, and the feebler are the winds blowing from opposite directions, immediately before the formation of the cyclonic vortex." These conclusions, based on well directed observations, have a most important theoretical bearing. W. M. D.

Books, Reprints, etc.

(67) **G. Hellmann:** Ueber gewisse Gesetzmässigkeiten im Wechsel der Witterung aufeinander folgender Jahreszeiten. Sitz ber Akad. Berlin, 12 Mar. 1885.

From a comparison of the Berlin records from 1719 to 1884, Dr. Hellmann concludes that the seasons named in the first column are most probably followed those in the second.

Very mild winter	Warm summer.
Moderately mild winter	Cool summer.
Moderately cold winter	Cool summer.
Very cold winter.	Very cool summer.
Very warm summer.	Cold winter.
Mod. warm summer.	Mod. mild winter.

The adjectives mild, cold, etc., imply departures from the normal means of their respective seasons.

W. M. D.

(68) **Rainfall and Weather Review** from Sept. 1, 1849 to Dec. 31, 1884. By James A. Barwick, observer sergeant of the Signal Corps, U. S. A., Sacramento, Cal 42 pp.

An interesting summary of meteorological results obtained at various points in California during a large number of years are given. H. H. C.

(69) **Weather Reviews and Reports** received,—ALABAMA Weather Service, 8vo, 5 pp. Prof. P. H. Mell, Director, Auburn.—Monthly Weather Review of the Meteorological Service of the Dominion of CANADA, large 8vo, 10 pp. with wind-diagrams, Charles Carpmael, Supt. Meteorological office, Toronto, Ontario.—Meteorological observations made at CARSON Observatory, Carson City, Nev.; Elevation 4630 feet, Single sheet, Chas. W. Friend, observer, Carson City.—ILLINOIS Crop Report, Illinois Department of Agriculture, Springfield, 60 pp. Chas. F. Mills, Secretary—MICHIGAN Crop Report, 8vo. 8 pp., Lansing, Secretary of State—MINNESOTA State Weather Service and Crop Reports, Carleton College, Northfield, 8vo, 12 pp. Prof. Wm. Payne, Director—MISSOURI Weather Service, 8vo, 4pp., 1 map of rainfall, St. Louis, A. Ramel, Assistant in charge, Washington University.—NEBRASKA Weather Service, 1 sheet, Prof, Swezey, Director, Crete.—Bulletin of the NEW ENGLAND Meteorological Society, 8vo, 10 pp., one map of stations, W. M. Davis, Secretary, Cambridge, Mass,—Report of the NEW YORK Meteorological Observatory of the Department of Public Parks, Central Park. Small 4to, 4 pp., Daniel Draper, Ph. D., Director.—Report of the OHIO Meteoro-

logical Bureau, 8vo, 56 pp., Columbus, E. H. Mark, Secretary.—TENNESSEE Crop Reports, published by the Bureau of Agriculture, 8vo, 24 pp., Nashville, A. J. McWhirter, Commissioner.

(70) **Report of the Meteorological Council of Great Britain to the Royal Society** for the year ending 31st of March, 1884. London, Feb. 1885; 122 pp., 2 maps.

The report is somewhat similar to the report of our Chief Signal Officer, and is composed of a general review of the work accomplished and in hand, accompanied by nineteen appendices. The work is considered under three heads, *Ocean Meteorology*, *Weather Telegraphy*, and *Land Meteorology of the British Isles*. The large number of ships owned by the British on most of which meteorological observations are taken, and the wide extent of British commerce and maritime interests render the department of ocean meteorology one of the most important of British meteorological labor. Special efforts were made from Aug. 1, 1882, to Sept. 1, 1883, while the International System of circumpolar observations was being carried out, to gain data over the ocean; and it is stated that on an average, observations at more than 400 positions were obtained for each day's chart. Charts from these data were stated to be in course of preparation. Two charts were given as an example of the method employed and a most interesting study they present. Under the head of Weather Telegraphy, it is stated that Great Britain was divided into eleven districts for weather forecasting, and that 48 per cent. of all the forecasts issued were completely successful and 33 per cent. nearly so, making a total of 81 per cent. considered successful, an improvement of 2 per cent. on the figures of the previous year; 77.8 per cent. of the storm warnings were considered successful, a slight decrease on the figures of previous years.

Under the head of Land Meteorology the stations are divided into five classes —observatories furnished with complete outfits of self-registering instruments, stations where the wind alone was self-registering, volunteer stations, telegraphic stations, and extra stations furnishing incomplete returns. There were seven observatories with self-registering instruments, but the maintenance of these was very expensive, and it was contemplated discontinuing four of them, in order to be able to apply the money to other work which was pressing on the *Council*, and was considered to be of more importance. The number of stations reporting by telegraph was 53, and the number of volunteer observers sending in complete reports was 74.

A synopsis of the scientific studies carried on under the auspices of the Council was given; and included inquiries into the cause and prevalence of London fog, into the amount of carbonic acid in London air, into the chemical constituents of London rain as compared with that of the country, on the motion of the upper currents by means of shell firing, on cloud photography, on hygrometry and evaporation, on the Krakatoa barometric wave, and on the diurnal variation of quantity and frequency of rainfall at the self-recording observatories.

The publications of the office were stated to be daily, weekly, quarterly (hereafter to be monthly), and annual reports. The expenditure during the year was £15,565. H. H. C.

CORRESPONDENCE.

COL. BENT'S OPEN LETTER TO CHIEF NIMMO.

ST. LOUIS, May 4, 1885.

Hon. Joseph Nimmo, Jr., Chief of Bureau of Statistics, Treasury Dep't, Washington, D. C.

DEAR SIR—Thanks for your Meteorological Statement which I herewith return, with some verbal corrections and criticisms of one or two paragraphs of your quotations from Professor Elias Loomis, of Yale College, and Captain Samuel H. Miles, Acting Chief Signal Officer U. S. Army; and which I shall here repeat with additional comments, as you desire:

Professor Loomis says: "Near the Atlantic coast the amount of rainfall is evidently increased by vapor which comes from the Atlantic Ocean. For the remaining portion of the United States east of the Rocky Mountains the vapor which furnishes the rainfall may come, to some extent, from these two sources (Gulf of Mexico and Atlantic Ocean), but it is chiefly derived from the chain of the great lakes, from the rivers, small lakes and collections of water from the moist earth."

The only criticism that I shall offer to this assumption is, to ask the Professor from whence came the vapor which gave rise to this "chain of great lakes, rivers, small lakes and collections of water from the moist earth?" and whence comes the vapor that now keeps them in such unvarying supply of water from year to year, if not from the prevailing west winds which come to this region from the Pacific Ocean?

Captain Miles says: "It seems probable that evaporation from the Kuro-Siwo is no more important than that from the remainder of the Pacific Ocean. The southwest wind that (prevails?) north of California passes over the Rocky Mountains and deposits rain on our Pacific coast undoubtedly draws most of its moisture from the Pacific Ocean."

To this I reply that the only "remainder of the Pacific Ocean" not covered by the tepid waters of the Kuro-Siwo is a narrow strip of water lying directly along the eastern coast of Asia, and to the west of a line drawn from the northeastern part of Japan to Behrings Straits; and which, being of the same general temperature as the west winds that come from Siberia and Central Asia, it can, of course, impart but little or no moisture to those winds; and it is not until these winds reach the tepid waters of the Kuro-Siwo, which cover the whole Pacific Ocean from Japan northeastwardly, and eastwardly to the shores of our continent, and extending from Behrings Straits to the Tropic of Cancer, that they begin to load themselves with moisture by evaporation from the Pacific Ocean; for the power of the atmosphere to produce such evaporation is in exact proportion to the dryness and low temperature of the wind as compared with that of the water at the time and place of its contact with these tepid waters from the Equator.

The climatic power, in temperature alone, of these tepid waters is forcible shown by such distinguished writers as Mr. James Croll, of England, and Commander M. F. Maury. In his work, entitled "Climate and Time," Mr. Croll says: "The quantity of heat conveyed by the Gulf-Stream (from the Gulf of Mexico through the Straits of Florida into the North Atlantic) is equal to all the heat which falls upon the globe within thirty-two miles on each side of the Equator," that, "the stoppage of the Gulf-Stream would deprive the Atlantic of 77,479,650,000,000,000,000 foot-pounds

of energy in the form of heat per day." Or, as the same fact is more popularly stated by Commander Maury in his "Physical Geography of the Sea," when speaking of the effect on the climate of Central America and Mexico, arising from the excess of heat carried off from them by the Gulf-Stream, says: "A simple calculation will show that the quantity of heat daily carried off by the Gulf-Stream from those regions and discharged over the Atlantic Ocean is sufficient to raise mountains of iron from zero to the melting point, and to keep in flow from them a molten stream of metal greater in volume than the waters daily discharged from the Mississippi River."

Mr. Croll further says, that, "were all ocean and aerial currents stopped, so that there could be no transference of heat from one point of the earth's surface to another, the difference between the temperature of the equator and the poles would amount to 218 degrees," and that, without ocean currents the globe would not be habitable."

Now, *the sea, the atmosphere and the sun are to the earth what the blood, the lungs and the heart are to the animal economy*, and it is not only the transference and equalization of temperature over the face of the earth that is accomplished by the circulation of the currents of the ocean and of the atmosphere, but also, in the Divine economy, the parallel beneficence of such a distribution of moisture as is necessary for the sustenance of animal and vegetable life throughout the world; and it is in this aspect of the question that it may be safely affirmed that, were the Kuro-Siwo shut out from the north Pacific, and the west winds coming to our coast be thus denied the moisture now obtained from it by their evaporation of its tepid waters and distributed by these winds over the continent, the whole of North America, north of the thirtieth parallel of latitude and west of the Alleghanies, would be an uninhabitable desert; and that, if all the ocean currents alone were stopped (regardless of the winds) so as to cut off the supply of moisture now obtained from them by the winds and distributed over the continents and islands of the world, such stoppage of the ocean currents would be death to the world as effectually and as completely as the stoppage of the circulation of the venous system is death to the life of man.

Any attempt, therefore, to solve the great and apparently intricate problems of meteorology, climatology, or even forestry, without starting the investigations from the ocean currents (which comprise a grand system of circulation embracing all the oceans of the world, and which is as sublime in its simplicity as it is beneficent in its life-giving influence upon the animal and vegetable kingdoms of the earth), will and must ever prove unreliable and unconvincing; because these currents—next to the sun—are the bases of meteorology and climatology by reason of the heat and moisture which they throw off to the atmosphere for distribution in all parts of the world. And as Commander Maury says: "An examination into the economy of the universe will be sufficient to satisfy the well-balanced minds of observant men that the laws which govern the atmosphere and the laws which govern the ocean are laws which were put in force by the Creator when the foundations of the earth were laid; and that, therefore, they are laws of order; else why should the Gulf-Stream, for instance, be always where it is, and running from the Gulf of Mexico, and not somewhere else, and sometimes running into it? Why should there be a perpetual drought in one part of the world and continual showers in another? Or why should the winds and waves of the sea ever clap their hands with joy or obey the voice of rebuke?"

With apologies for my delay in answering your letter, occasioned by unavoidable engagements, and regrets that I am compelled to touch so briefly upon the mass of evidence that lies on every hand to sustain the hypothesis advanced in my

address to the Cattle-growers' Convention, I beg you will accept my grateful acknowledgments for your earnest interest in this matter, and believe me

very respectfully
and truly yours,
SILAS BENT.

PREVENIENCE OF WEATHER CHANGES.

TO THE EDITOR:—In the May number of the METEOROLOGICAL JOURNAL you have a report on experiments at Johns Hopkins University upon Atmospheric Electrical Conditions, and you state as a peculiar phase the fact that there is a "fall of potential" 2 h. to 20 h. *before* rain—(p. 51).

This struck me as so coincident with an idea I have been working up that at the risk of appearing premature I will send you the point even before I get the full details I am accumulating.

In a general way I had noticed that in some of the *large* changes of weather for this locality, specially those coming from the west, the change itself has been accomplished *from 8 to 12 hours before the time predicted.* And only this spring did I determine to gather specific data regarding it. I have a few special records but not enough to tabulate and send. One difficulty for the present is that larger changes only are marked enough for my purpose in the winter.

But I will keep at it and report when I have a definite result.

In gathering data from the fulfillments, evidently we have a large field for study in merely marking out the limiting lines of storm movements.

Other claims upon my time sometimes break in upon all my recreative work, but I hope to be able to keep a general watch and may get at some facts for this locality which may be useful.

Yours truly,
JOHN R. HOOPER.

BALTIMORE, May 13, 1885.

EFFECTS OF A LIGHTNING STROKE; ALSO INFREQUENCY OF THUNDERSTORMS IN IDAHO.

TO THE EDITOR:—On the afternoon of May 13, 1885, during a thunderstorm, about sixty miles from this station, a remarkable escape from lightning occurred. As two boys aged 14 and 15 years were riding across the open prairie they were struck by lightning; both of the horses were killed instantly. One of the boys escaped uninjured, the other one had his clothing stripped from his person, and his skin blackened as though burnt with powder. The injured one had a large pocket knife in his pocket, which was thrown nearly 20 feet from his body. The boy was insensible for a short time, but after regaining his senses was unable to hear anything being at this time perfectly deaf.

The case is the most mysterious that I have ever read of, in regard to being struck by lightning, and I cannot account for his escaping alive and both horses being killed. I wish to state that during my two years' sojourn at this city the case in question is the only case of persons being struck by lightning during that time. Also that thunder storms are of rare occurrence, and are very light as in comparison with those which occur in the east.

I can give no reason for the horses being killed and both boys escaping unless on account of the boys having received the stroke first, and as they were riding, the horses must have proven to have been better conductors, and thus the electric current passed to the earth.

Very respectfully,
C. E. BUTLER,
Pvt. Signal Corps, U. S. Army.

LEWISTON, IDAHO, May 24, 1885.

RED SNOW.

TO THE EDITOR:—In the winter of 1835—or perhaps the year before or after

—on a clear night with bright moon, the people of Northwestern New England found the snow with deep red color. The color was general and lasted several hours. Can you give me any further information about it, especially as to its cause? H. W.

[We would need fuller details before we could hazard an explanation. Perhaps some of our New England readers could give them. We would like to know if there was any deposit on the snow afterwards.]

COLD SPRINGS IN NEW ENGLAND.

To the Editor:—It is asserted here that this has been the coldest spring ever seen in New England. Can you tell us of any others which have been as late? Vermont. W. M.

[We have no reference list of late springs in New England. There was a series of late springs in the early forties. In 1842, in Vermont, snow fell on the 11th of June to the depth of 5 inches, and in 1843 it fell in Jefferson Co., N. Y. on June 6th to a slight depth.]

PUBLISHERS' DEPARTMENT.

Of the many mineral waters which have been placed on the market from time to time, there is none which has perhaps enjoyed a greater reputation as a dietetic table water than the "Waukesha." The "Bethesda Water" achieved a great popularity and extensive sale, and now it has been replaced by the Waukesha Glenn Springs—a water which chemical analysis show to be identical with the "Bethesda" before the latter spring was rendered worthless by the creation of the former. Our readers' attention is called to the analysis of this famous water, and testimonials regarding it in another column.

THE GRIFFITH CLUB MICROSCOPE.

TESTIMONIALS.

The following are extracts from letters received within a few months:

Roswell Park, M. D.. Prof. in University of Buffalo:

The Club Microscope has safely arrived, and it is a beauty. If you ever want a written testimonial from me, it will give me pleasure to furnish it.

Prof. H. C. Griffis, Central High School, Bimghamton, N. Y.:

We thoroughly believe the Griffith Club Microscope is the best.

F. L. James, M. D., Ph. D., Editor Microscopical Dep't "National Druggist," St. Louis, Mo,:

For general work, especially for students who have no fixed habitation, I think the Griffith Club perfection. The capabilities of the model are unlimited. It will do whatever any other instrument can do. Its fine adjustment is excellent and embraces features which are possessed by no other instrument, with which I am acquainted; as to finish it is superb.

Robert Aberdeen, M. D., Syracuse, N. Y.:

I received your Griffith Club Microscope day before yesterday—set it up and like it very much in every particular.

Rev. A. B. Harvey, The Author, Taunton Mass:

It is, indeed, an admirable instrument; the best I know of, for what you clearly meant it for. A *multum in parvo* both as a home and a travelers stand.

J. T. Greenleaf, M. D., Owego, N. Y.:

The Griffith Club is a perfect stand. I don't want any better; can do any thing I want to with it.

Prof. Sarah F. Whiting, Wellesley College Mass:

The general plan of the stand, size, heigth, firmness, adjustments is perfect, and the compactness with which it can be packed, turn-table included, causes it to be without a rival.

Prof. Ada M. Kenyon, Buffalo Normal School:

My Stand is like Wagner's music in that it bears the very closest acquaintence. It seems to me that for price and size there is nothing in the market that can approach it in beauty and adaptibility to work.

For circulars address,

E. H. GRIFFITH,
Fairport, N. Y.

[From Issue of "Gems of the Northwest," by C., M. & St. P. Ry.]

THE ONLY PURE WAUKESHA WATER

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THE WELL KNOWN "QUEEN OF WATERS."

Reigns alone among Natural Dietetic Table Waters. Its numerous competitors appear to have, one after another, fallen away until it has no rival. The only spring in Waukesha that remains at one temperature, both summer and winter—*i. e.* 48°. The Waukesha Glenn Natural Mineral Water issues from a spring deeply imbedded in a rock, and is therefore of absolute organic purity.

What the Highest Authority in New York Says.

Certificate of Analysis.

LABORATORY OF THE SCHOOL OF MINES, COLUMBIA COLLEGE, New York, Nov. 10.

SIR—The sample of Mineral Water from Wisconsin, marked "Glenn Mineral Spring," submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Chloride of Sodium	1.1944 grains.
Sulphate of Potassa	0.4848 "
Sulphate of Soda	0.6212 "
Bicarbonate of Lime	15.9764 "
" of Magnesia	12.5795 "
" of Iron	0.0866 "
" of Soda	0.7594 "
Phosphate of Soda	0.0084 "
Alumina	0.0466 "
Silica	1.0497 "
Organic Matter	1.2160 "
	34.0230 grains.

This water appears to be identical with the Bethesda Water as it was before the Glenn Spring was created by tapping the Bethesda stream.

Respectfully, your obedient servant,
C. F. CHANDLER, Ph. D.,
Professor of Analytical and Applied Chemistry.

THE WAUKESHA GLENN SPRING was created by opening a new outlet for the Bethesda stream, since which time it has caused the flow from the Bethesda Spring in dry weather to be almost exhausted, thereby rendering the Bethesda Water comparatively worthless, as shown from four analyses by Prof. C. F. Chandler, and other positive proofs.

THE GLENN MINERAL WATER is the only diuretic water known in the world which acts directly upon the secretion of the liver, kidneys, urinary and generative organs, and is Nature's Sovereign Remedy for that numerous class of diseases that afflict the human family—and as medical statistics show us, comprise over one-half of those which terminate life.

This water will keep fresh and sweet, tasting neither stale or flat, and is the only Mineral Water from Waukesha that will keep, which is positive evidence of its superior medicinal properties.

Waukesha Glenn Mineral Spring vs. Bethesda.

Have the curative properties of the Bethesda Spring Water depreciated, and are their ORIGINAL VIRTUES found to exist to-day in the waters of the GLENN SPRING? This is the great paramount question overshadowing all others; and its solution is not to be determined by what R. Dunbar or I may say. It is not with me that these parties have their quarrel, but with SCIENCE, which, through the highest chemical authority on this continent, Prof. C. F. Chandler, of the School of Mines, Columbia College, New York, declares th t while the mineral solids in the Bethesda Water have fallen off fully 50 per cent. from what they were originally the organic matter has increased fully 100 per cent., and further, that the exact properties which once gave these waters their wonderful curative powers, are now found in the waters of the Glenn Spring.

Read the evidence as presented in the several analyses made of these respective waters. The original analysis of the Bethesda Water, as shown in Col. Dunbar's circular, gives:

Total Salts	35.710 grains.
Total Organic and Volatile Matter,	1.983 "
Leaving as Solid Matter	33.727 grains.

These WERE the constituent elements of this far-famed water that carried life, vigor and health to all that drank at its healing fountain. Have they been preserved and maintained? Let us see. The two following recent analyses of water from this same Bethesda Spring, and by this same distinguished scientist, called forth the following certificates:

Certificate of Analysis.

New York, Sept. 14.

SIR—The sample of water marked "Bethesda" (Dunbar's Spring), submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Total Solids	21.286 grains.
Organic and Volatile Matter	3.848 "
Solid Minerals	17.438 grains.

Respectfully, your obedient servant,
C. F. CHANDLER, Ph. D.,
Professor of Analytical and Applied Chemistry.
To J. K. GLENN, Esq., New York.

DEAR SIR—The sample of Spring Water from Caswell, Hazard & Co., marked "Bethesda Water" (Dunbar's Spring), submitted to me for examination, contains in one U. S. gallon of 231 cubic inches:

Total Solids	21.846 grains.
Organic and Volatile Matter	4.082 "
Mineral Salts	17.764 grains.

Respectfully, your obedient servant,
C. F. CHANDLER,
Professor of Analytical and Applied Chemistry.
To J. K. GLENN, Esq., New York.

WAUKESHA GLENN.

TESTIMOMIALS.

For about two years I have been troubled with my liver, resulting in loss of flesh from my usual weight of 170 pounds down to 120, with a sure prospect of final end in a very few mouths—so all the doctors said. Finally I concluded to try Glenn Spring Water, that you shipped me from the springs. For two months the effect was more than astonishing, from death (sure) to life. It was w nderful. June 1st I was able to take the road again and have not lost a day since, getting better every month, gaining from 120 to 165 pounds. Those who saw me last winter did not expect me to live till July and will now testify that all I say,and even more, would be true May the Glenn Spring continue to run pure water for ever and ever.

D. W. C. HOUSE,
Kansas City, Mo., Moline Plow Co.

PHILADELPHIA, August 6.

DEAR SIR—It is with great pleasure that I have to inform you of the wonderful effect the water of your springs has had upon my wife, who was unable to leave her room with chronic Bright's Disease. It seemed to affect every part of her body with pain, and sleepless nights, so that the doctor gave no hopes of her; but since drinking of the Glenn Mineral Water she has not only been able to leave her bed and room, but to take long walks of one and two miles, and is fast improving in health and strength. We have now done away with all other remedies, only using the water, which keeps perfectly sweet in the manner you put it up. You will please send me at once another barrel.

Yours respectfully,
JOHN RESTEIN.

48 HATHAWAY ST., CINCINNATI, April 22.

DEAR SIR—Enclosed you will find check for which you will please send me two barrels Glenn Mater. I have several customers who have received substantial benefit from the use of the water, and as for myself, I think I am entirely cured of my kidney trouble, after five years affliction. The water I bought of you last summer is just as clear and sweet now as water that I drank from your spring when I was there, while all the Bethesda Water in this market is off in color and stringy in substance.

Yours truly, THOS. VAN NAME

OVID, MICH., Sept. 6.

DEAR SIR—The half barrel of Mineral Water I ordered for Mr. Shattwack has helped him amazingly. For several months he has had to use a catheter, but that necessity was entirely removed after using the water a few days. As regards my own case, I would say that I am about cured of Bright's Disease. You will please ship me another barrel; it is for Mrs. J. Skerritt, of Victor.

Yours truly,
W. HATHAWAY.

CLEVELAND, O., July 5.

DEAR SIR—Please send one barrel of the Glenn Mineral Water to each of the following addresses. My friend, Mr. Sellors has found so much benefit from the water I ordered for him that he tells me that he has ordered another barrel, and has just received it, and I am happy. I feel tip-top, and I am a living advertisement of your excellent water.

Yours truly, W. WILSON.

AMES, N. Y., August 24.

DEAR SIR—Send me another barrel of water. It is for a neighbor, Mr. B. Mount. I let him have ten gallons from my barrel, and it has helped him more than two years of treatment from the most skillful doctors of the Mohawk Valley.

Very truly,
SAMUEL STEVENS.

Please send me, as before, one barrel Waukesha Glenn Water. The Waukesha Glenn Water is the best in the world, and my physician says, the great est. It is deserving of all praise.

GEORGE H. PEABODY,
118 East Eighteenth St., New York.

BOSTON, MASS., July 12.

DEAR SIR—Please send me five barrels of Glenn Water. People here are learning the merits of Glenn Water I like the water better the more I know of it.

Your truly,
JOHN SULLIVAN.

These, with the thousands of other actual cures and benefits, ought to convince the most skeptical. The medical profession, without exception, indorse and prescribe it with the CAUTION to AVOID the more harsh spring water, also those containing SALT in imitation of foreign waters.

THE WAUKESHA GLENN is the only specific known for the hitherto incurable diseases —Diabetes, Bright's Disease and all Kidney Affections. It has been tested by thousands whose unsolicited testimonials are open to the public, and furnished to all who desire, MAILED FREE.

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Ann Arbor, Mich., Oct. 1st, 1884